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THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-153 University Ave. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. IX Publication Office, Toronto—January, 1916 No. 1

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TRADE **PENBERTHY** MARK

BRASS VALVES

"THE ALL QUALITY LINE"

REGRINDING AND **COMPODISK**

With the Metal Disc Registered for 200 lbs. Pressure	With the Composition Disc Registered for 175 lbs. Pressure

IN ORDER TO GET

this fine valve you have got to specify our make, and to be sure, look for our name cast on the body of every valve. You will never know "real value comfort" until you have used them.

"IT'S A GOOD NEW YEAR'S RESOLUTION"

Manufactured by

Penberthy Injector Co., Limited
WINDSOR, ONTARIO

FILE COPY

We Build:

WATER TUBE BOILERS like this

HORIZONTAL RETURN TUBULAR BOILERS
Standard or Special like this

And ALL KINDS OF TANKS like this

Also all kinds of Marine Boilers, Land Boilers, Plate Work, etc.

Send us your specifications and blue prints.

POLSON IRON WORKS, LIMITED
SHIPBUILDERS, ENGINEERS AND BOILER MAKERS
TORONTO, ONTARIO

Reliable Power

If you are buying your power from outside your plant it is always at the mercy of the elements. This is especially the case in Winter, when power line interruptions are of frequent occurrence.

Snow, ice and sleet will take their toll and you will be lucky indeed if your men are not frequently idle half a day at a time waiting for the "juice" that can't come through because "the wires are down again."

Why not produce electric light and power on your own premises? It can be done **and profitably, too.**

Bulletin "The McEwen Engine" describes and illustrates these Canadian-built Engines fully. Every engineer should have a copy on his bookshelf.

SEND FOR IT

McEWEN ENGINES

are built specially for use in the isolated plant.

Ability to absorb overload, low maintenance cost, simplicity of operation and great strength of all parts are features that distinguish McEwen Engines.

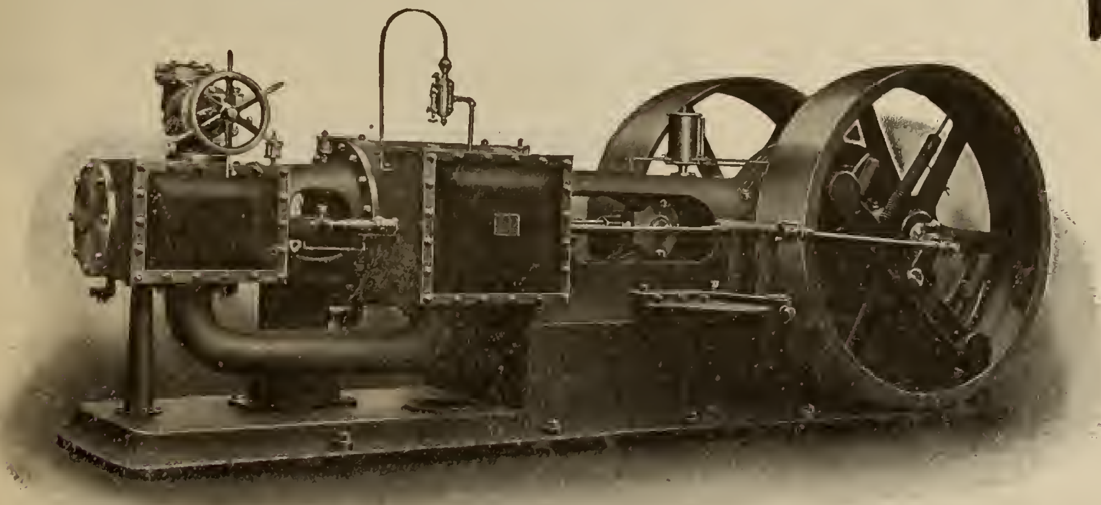
In hundreds of Canadian power plants producing their own power you will find McEwen Engines in use. They are in operation because they are developing power that is not only **cheap** but **absolutely reliable** as well.

McEwen Engines are built for continuous duty—they will run with a minimum of attention seven days in the week and will produce power that costs no more than you pay outside, and that you can be absolutely sure of year in and year out.

Built in simple and compound units up to 700 H.P. There is a size to suit your needs.

The Waterous Engine Works Co., Limited

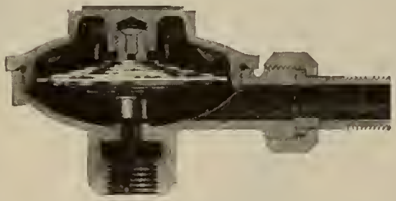
BRANTFORD, CANADA



The C. A. Dunham Co. Limited Staff and Branch Office Managers

Wish to extend their hearty New Year's wishes and thanks to the many users of Dunham Radiator Steam Traps, for their co-operation and patronage during the past year.

And with a feeling of confidence that present users are receiving the maximum of service from Dunham Products invite others to join the ranks of satisfied Radiator Steam Trap users.



"MADE IN CANADA"

C. A. Dunham Co. Limited

Head Office and Works,
TORONTO, CANADA

OTTAWA—214 Booth Bldg.
MONTREAL—Room 20, 11 St. Sacrament St.
FORT WILLIAM—Plumbing & Engineering Supply Co.
HALIFAX—Eagar, Coombs & Co., Ltd., McCurdy Bldg.
VANCOUVER—520 Duncan Bldg.
CALGARY—Metals, Limited.
WINNIPEG—405 Tribune Bldg.

"Hoyt Frost King"

This Babbitt has been tested for years in many of the large power plants, and has proven such a success, we are placing it on the market as a first-class, all-round Babbitt. It will not only take care of high speed, but will stand up to heavy duty work in an extraordinary way.

For saw mills, planing mills, threshing engines, traction engines, rolling mills, pulp machinery, and all classes of stationary engines, it is without equal.

HOYT'S NICKEL GENUINE

Owing to the greater service required of Babbitt, as modern machinery developed, it was necessary for us to design an alloy that would meet with these new requirements. Our Nickel Genuine, for heavy duty, high speed work, is probably as perfect as an alloy can be made. It is especially designed for use in gas engines, gasoline engines, and all classes of marine engines, and is especially adapted for automobile engines.

This alloy is exceedingly tough and durable.

Hoyt Metal Co.

Factory and Offices :
EASTERN AVE. and LEWIS ST.
TORONTO, CANADA
New York, N.Y.; London, Eng.; St. Louis, Mo.

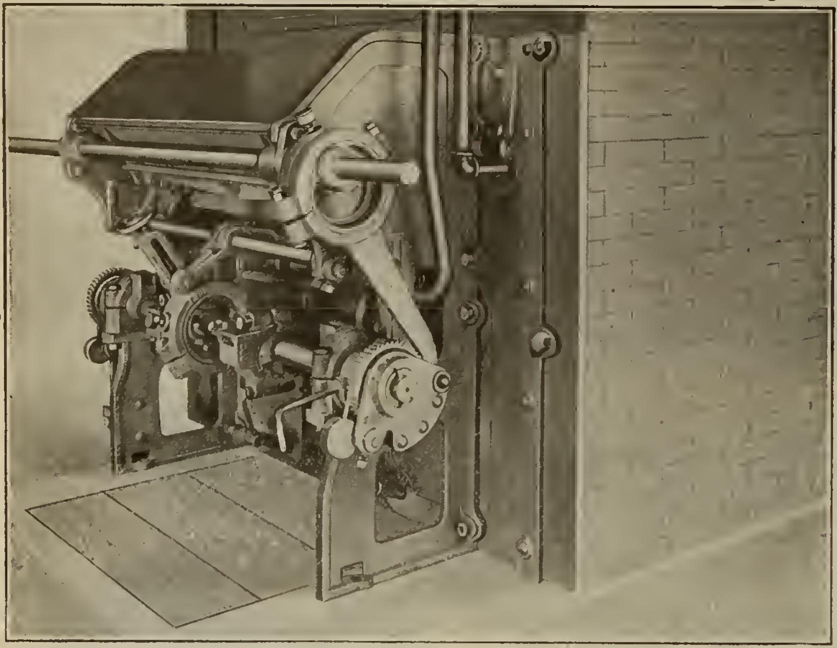
Important Notice to Engineers, Architects, and Contractors in the Dominion of Canada:

Dating January 1st, 1916, the well known Toch Brothers' R.I.W. Products, which have been made heretofore at Oakville, Ontario, will be manufactured in connection with the International Varnish Company's factory in Toronto.

The increased facilities will enable us to put out a more extensive line of our specialties throughout the Dominion, and increased distributing facilities will be arranged for.

REMEMBER IT'S WATERPROOF
R.I.W. DAMP RESISTING PAINT CO.
TOCH BROTHERS
OAKVILLE, ONT., CANADA

INTERNATIONAL VARNISH CO.
TORONTO, ONT., CANADA.



No. 4807, Fulton Watercooled Stoker Under an H. R. T. Boiler. Flush Front.

Lower Fuel Costs by Installing the

FULTON STOKER

Some of the recent installations in Canada:

Chipman-Holton Knitting Co.,
Hamilton, Ont.

Hinde & Dauch Paper Co., Ltd.,
Toronto, Ont.

Canada Forge Company, Ltd.,
Welland, Ont.

City Dairy Company, Ltd.
Toronto, Ont.,

City of Toronto, Pumping Station

The above aggregate 3,010 H.P.

Send for Bulletin F-106 P—a postcard will bring it.

Made in Canada
15,000 h.p. in use

THE HARE ENGINEERING COMPANY
LIMITED
Head Office: 115 King Street East, Toronto, Ontario

Sales Agencies: Montreal, Port Arthur, Winnipeg, Calgary, Edmonton, Vancouver and Chicago, Ill.

YOUR BOILER ROOM

is where large profits can be made by installing a

JONES Underfeed Stoker

It is a **BIG** paying investment in the **SMALL** plant.

It is a **BIGGER** paying investment in the **LARGER** plant.

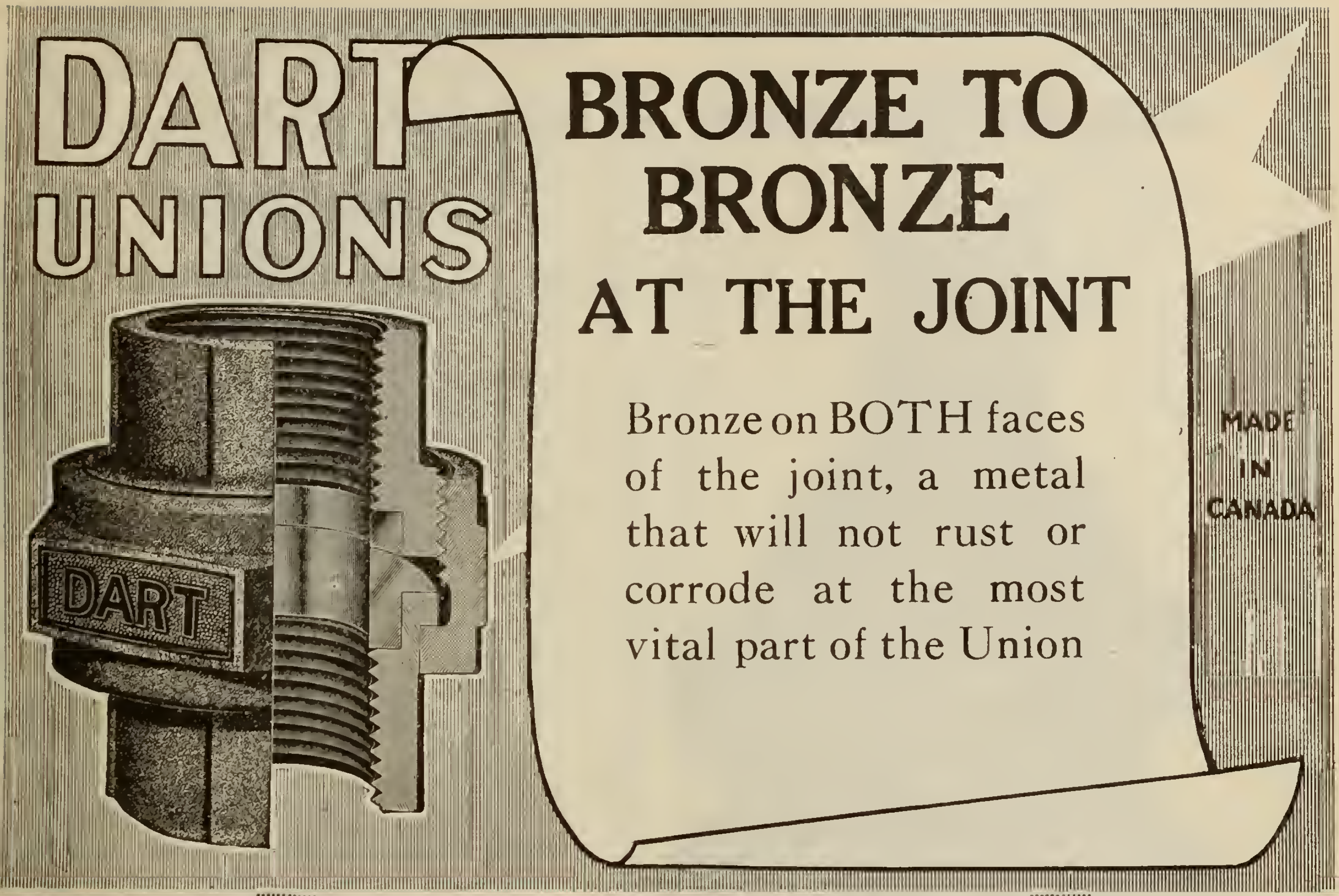
Fuel saving from 15% to 25% interests most steam plant owners.

Hundreds of **JONES STOKERS** are to-day making these savings in plants like your own.

Have us report on the cost and merits of equipping your plant. **The JONES STOKER is made in Canada.** It is the simplest stoker built; fewer parts and none moving in contact with the fire; no grates; no losses through grate bars; no smoke.

May we send you descriptive booklet?

JONES UNDERFEED STOKER COMPANY, LIMITED
National Trust Building, Toronto



DART UNIONS

BRONZE TO BRONZE AT THE JOINT

Bronze on BOTH faces of the joint, a metal that will not rust or corrode at the most vital part of the Union

DART

DART UNIONS have heavy thread ends and nut

Ample strength in all parts to prevent stretching; substantial shoulders on end and nut makes pulling apart impossible.

Straight way through fitting

No cored parts on recesses to hold moisture and sediment or obstruction to retard the flow.

Easily connected

The ball-shaped joint makes the connection so long as the nut can be started on its thread.

Reputation

The Dart's reputation is based on the opinion of others; ask anyone who has had experience with Dart Unions regarding their efficiency.

Manufactured by

DART UNION CO., Limited
TORONTO

Sold by all Jobbers

JENKINS BROS.'

Type "K"

Iron Body Gate Valves

STANDARD PATTERN

MADE IN CANADA

From the Highest Grade Materials by Experienced Workmen

Are guaranteed to remain tight indefinitely under the conditions experienced in a Modern Power House. They are equally adapted for service duty on hydraulic pressure lines.

The globe-shaped bodies of uniform thickness with the metal distributed in easy curves have no superior in strength and rigidity. The spindles, seat-rings, bushings, wedge-faces or discs and disc-rings are made of the highest grade of bronze, accurately machined, of ample strength.

All parts are interchangeable.

Approved for use in Ontario and the Western Provinces by the Depts. of Public Works.

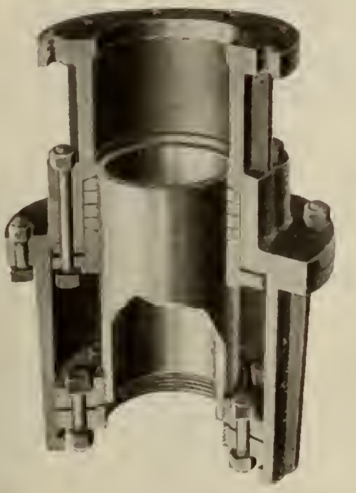
Fig. 402

Write for Catalog 8

Jenkins Bros.,
Limited
103 St. Remi Street
MONTREAL

TRADE
JENKINS
MARK
Jenkins Bros

The advertiser would like to know where you saw his advertisement—tell him.



Ross Guided Expansion Joint

THE ROSS EXPANSION JOINT consists of the well-known slip joint, with the improvement of a removable guide. This guide eliminates the strain that might be placed on the joint due to sagging of the pipe line, and thereby removes the only reasonable objection there has been to the slip joint type of expansion joint.

THE ROSS EXPANSION JOINT may be repacked, or packing adjusted, without removing it from the pipe line. No special tools are required. On account of the long traverse of the ROSS EXPANSION JOINT, the minimum number are required.

Built in sizes up to 24 in., and for working pressures up to 225 pounds.

MANUFACTURED BY

Alberger Heater Company
BUFFALO, N.Y. CHICAGO, ILL.

GENERAL SALES AGENTS

The Canadian Fairbanks - Morse Company, Limited

St. John
Quebec
Toronto
Winnipeg
Calgary
Vancouver

Montreal
Ottawa
Hamilton
Saskatoon
Edmonton
Victoria

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

SPECIFY "DICK'S BALATA" ON YOUR BELTING ORDER

It is waterproof — does not stretch—is stronger than any other belt—does not slip—is perfectly uniform.

Read the following letter from one of the many hundreds of satisfied users of Dick's Balata Belt:—

Dominion Iron & Steel Co., Limited

The Canadian Fairbanks-Morse Co., Ltd.,
Halifax, N.S.

Dear Sirs:—

We have used a considerable quantity of Dick's Balata Belting, both for drive and conveyor purposes, and from the results obtained, as compared with other makes of Balata Belting with which we are familiar, we consider it superior to any other grade of Balata Belting which we have used here.

Yours truly,
Dominion Iron & Steel Co., Limited
(Signed) H. J. McCann,
Purchasing Agent

Dick's Balata Belt will give you the same satisfactory results.

Let us quote you on your specifications.

The Canadian Fairbanks - Morse Company, Limited

St. John
Quebec
Toronto
Winnipeg
Calgary
Vancouver

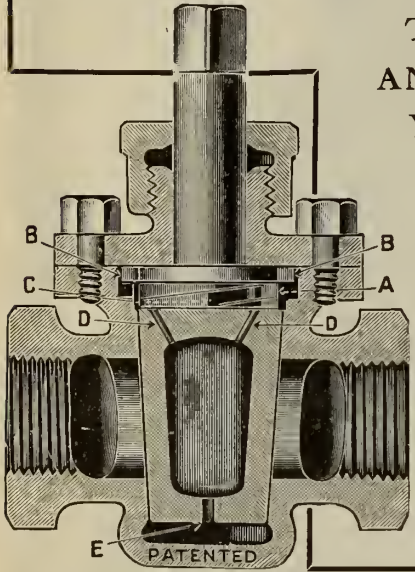
Montreal
Ottawa
Hamilton
Saskatoon
Edmonton
Victoria

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Engineers of wide experience say that

Homestead Valves

are the best for all Water, Air, Steam Lines



TRY THEM AND SEE FOR YOURSELF

Our new descriptive circular is just out. Drop a card for one today—it will prove invaluable.

Homestead Valve Mfg. Co.

Pittsburg, Penna.

Works, Homestead, Penna.

MASON

Reducing Valves

Pump Regulators
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company

BOSTON, MASS.

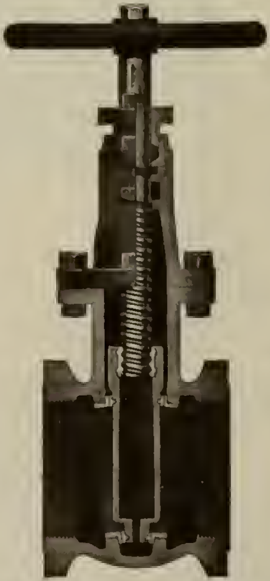
CANADIAN AGENTS

H. L. PEILER & CO, MONTREAL and TORONTO

KERR

("New KEYSTONE" Pattern) GATE VALVES

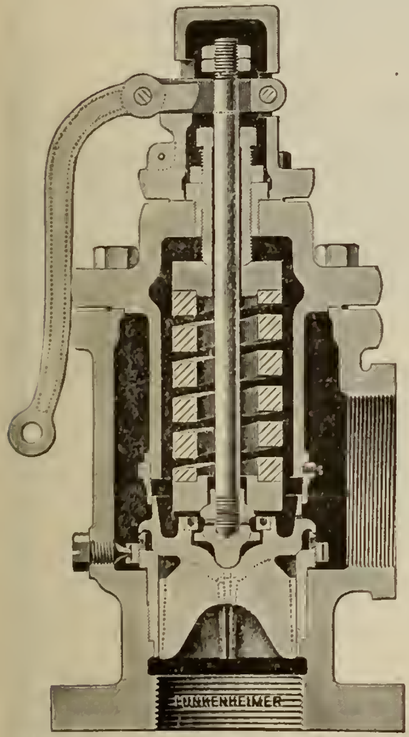
If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the " Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**



Safe from danger—

of over pressure, when the boilers are equipped with

LUNKENHEIMER Pop Safety Valves

Because : They are very sensitive to excess pressure, the "pop" is instantaneous. and the relief free and unobstructed.

Will not stick, chatter or hammer: will relieve the over-pressure only, admit of being finely adjusted, and the amount of "pop" can be regulated to suit individual requirements.

Provided with lock-key attachment, to guard against their being tampered with, and provision is made for inserting inspector's seal.

The high-grade materials used are particularly adapted to the purpose. All parts are made to gauge and are renewable. Seating surfaces are regrindable.

BRONZE and IRON BODY BRONZE MOUNTED PATTERNS, for working steam pressures up to 250 pounds.

Your local dealer can supply you; if not, write us.

WRITE FOR CATALOG.

THE LUNKENHEIMER CO.

—"QUALITY"—

Largest Manufacturers of High-Grade Engineering Specialties in the World
CINCINNATI, O., U.S.A.
New York Chicago Boston London
4-7-43

Awarded MEDAL OF HONOR Panama-Pacific International Exposition and GRAND PRIZE Panama-California Exposition.

FIRE BRICK

Elkco Elk Steel St. Marys
Keystone

These brands of Elk Fire Brick provide a type for every kind of furnace. Special attention given to Fire Brick for boiler settings.

We carry in stock a large variety of sizes and shapes. With our annual capacity of 3,500 cars we are able to fill largest orders.

Write for catalogue of shapes carried in stock.

Elk Fire Brick Company
of Canada, Limited
HIGH-GRADE FIRE BRICK AND CLAY
Federal Life Bldg., Hamilton, Canada

Ever see a "Bennis" Stoker at work?

Ever notice the smile on the face of the Engineer when it's carrying the "peak" of the load?

It's the smile of a satisfied man—*He knows.*

It means cheap steam—plenty of it.

It means low running costs, less wear and tear on the boiler plates, less trouble, less worry.

That's why we are kept busy.

Illustrated Catalogues on request.

The G. H. TOD CO.
10 Croft Street TORONTO
601 Union Bank Bldg. WINNIPEG

¶ Six years ago this well-known hotel needed a boiler tube cleaner. A trial of the **Dean** quickly convinced the management of its superiority over other types of cleaners for

Water-Tube Boilers

¶ The Dean cost just a little more, but that their early judgment was sound if proven by the fact that the Dean has taken care of all their boilers ever since, removing the scale thoroughly and completely—**the total upkeep cost for six years being $4.09 (a yearly average of 68 cents!)**

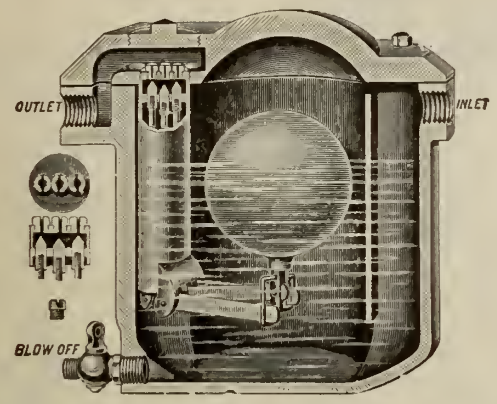
¶ When one stops to consider the high yearly repair charges for other mechanical cleaners, together with the excessive cost for "water treatments," is it any wonder the engineer of the **King Edward** swears by the Dean —and **not at it?**

¶ For either water-tube or return tubular boilers, the **Dean Boiler Tube Cleaner** is pre-eminently efficient, as well as the least costly for maintenance

¶ *You may try a Dean in your own boilers—at our expense—if you care to. Address either office for full particulars.*

The William B. Pierce Company

Buffalo, N.Y., Address, 153 Ellicott St.
Montreal Address, 201-2 Coristine Bldg.



Wright

"Emergency"
High Pressure
Continual Flow
Steam Trap

Three Valves. Great Capacity.

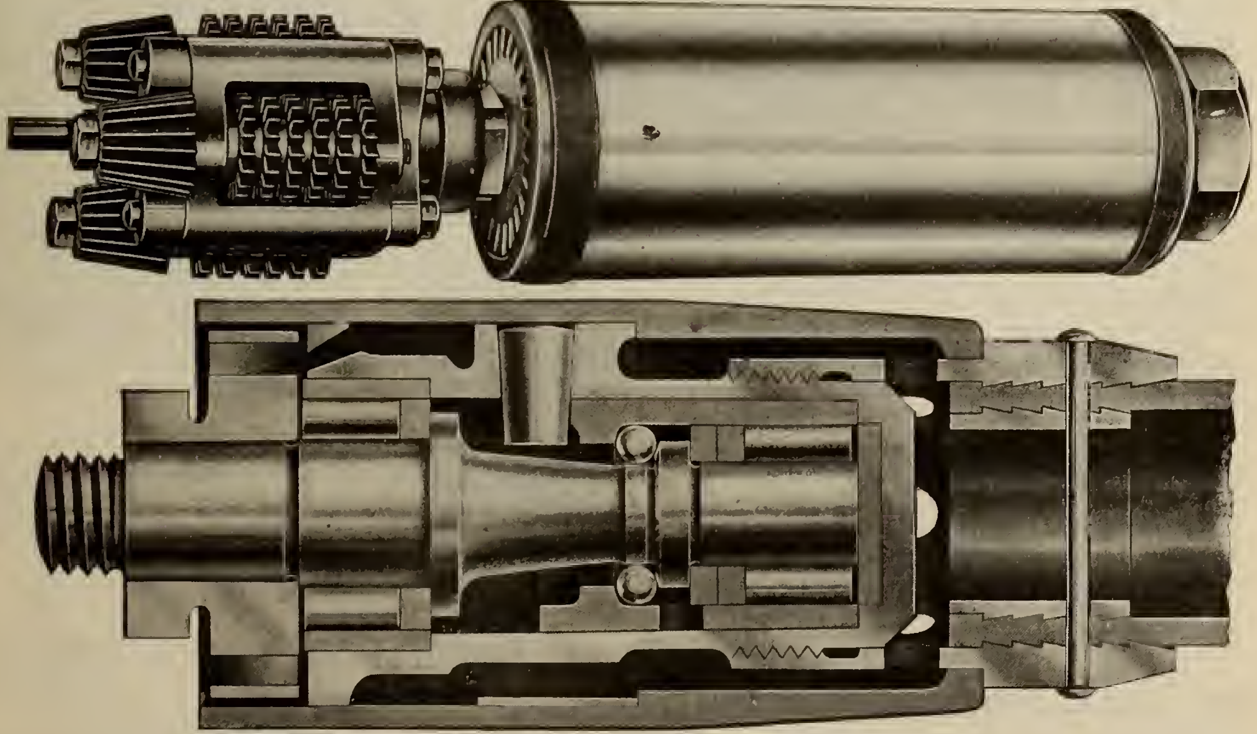
A steady and continuous drainer of accumulating condensation. Marvellous in efficiency. Shipped subject to trial and return if results are not satisfactory.

DROP A LINE FOR CATALOG

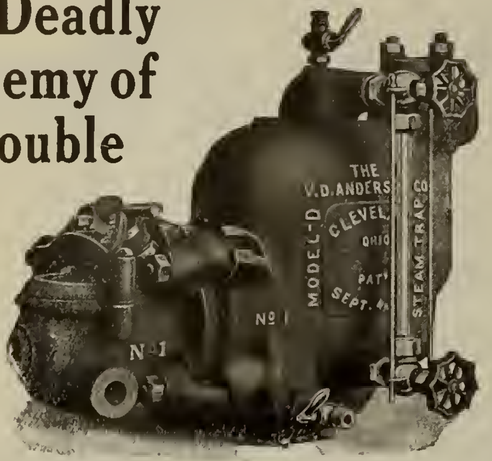
DARLING BROS., Limited
15 Ottawa Street, MONTREAL
TORONTO WINNIPEG ST. JOHN, N.B.

ROTO TUBE CLEANERS

For boilers, economizers and condensers—more steam with less coal. Air or Steam and Water-Driven types. Highest speed and efficiency.



CATALOG? **THE ROTO COMPANY, HARTFORD, CONN.** *CATALOG?*



A Deadly Enemy of Trouble

The moment you connect up

The Anderson Model "D" Steam Trap

all heating troubles leave

It is a positive, steady and reliable drainer.

Any varying amount of condensation within its capacity is easily disposed of because the "Anderson" automatically adjusts itself to suit.

The escape of live steam is impossible because the valve is always locked with at least three inches of water.

You can change the valve and valve seat from high to low pressure, or vice versa, in five minutes without breaking a single steam joint or pipe connection.

The Strainer and Sediment Chamber prevent sediment or scale getting into the valve.

Perfect in every detail, accurately built of materials best suited for the purpose. Every part absolutely interchangeable.

The V. D. Anderson & Co.

1935 West 96th St., Cleveland, Ohio

CANADIAN DUPLEX

Return Steam Trap

(TWO Traps in ONE)

HERE is a guaranteed Return Steam Trap—covering both construction and operation in service.

Furthermore you can put it in *your* plant on 30 days' free trial.

Could we show a greater degree of confidence in this "Modern Trap for Modern Needs?"

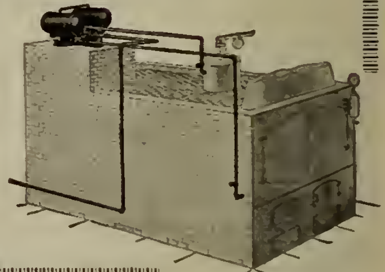
Canadian Duplex Steam Trap Co.

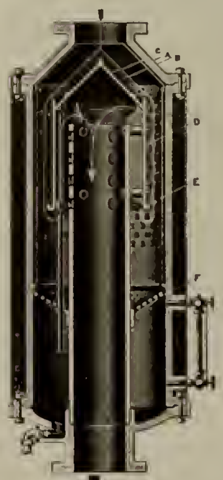
WALKERVILLE
Ontario

For
Coil Drainage
Water Lift
and Boiler
Feeding

Get Full Particulars

Write





"About a Good Separator"

This is the title of a little book recently published and which you ought to read. It describes the engine wrecks and accidents of common occurrence fifteen years ago and how these wrecks and accidents were overcome by removing water from the steam. It will be sent to you free.

SWEET'S SEPARATORS

For Steam or Oil

deliver live steam 98.8% dry and remove 99% of the oil in exhaust steam. Tests, proving these figures, are fully set forth in catalogue; 7,000 have been put into service in the past fifteen years and 3,500 have been sold on repeat orders. Built in all styles and sizes adapted to the needs of every power plant.

Write for descriptive catalogue.

DIRECT SEPARATOR COMPANY

820 South Geddes Street SYRACUSE, N. Y.

General Sales Agents:

Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Vancouver, Victoria.

Insist on "Genuine Detroit" Lubricators

Since 1867 the Detroit Lubricator Company has maintained the leadership in the manufacture of an efficient lubricating device for every purpose.

Over half the lubricators in the world are Detroits, and this demand for "Genuine Detroit" Lubricators is the demand for *quality*.

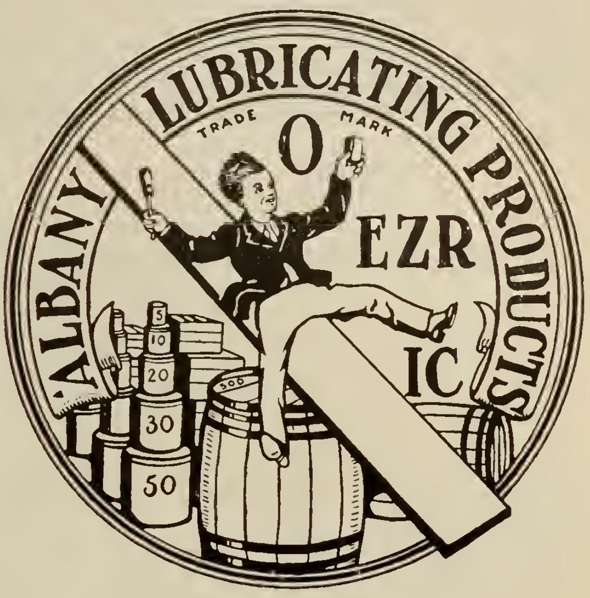
Naturally a product with the reputation of the Detroit has many imitators—some of the imitations being sold on the strength of looking like the Detroit and some as being "just as good as the Detroit."

For your protection we mark every package with the above trade-mark—look for it and see that you get the genuine.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONT.

Largest manufacturers of lubricating devices in the world



FORTY-EIGHT YEARS OLD

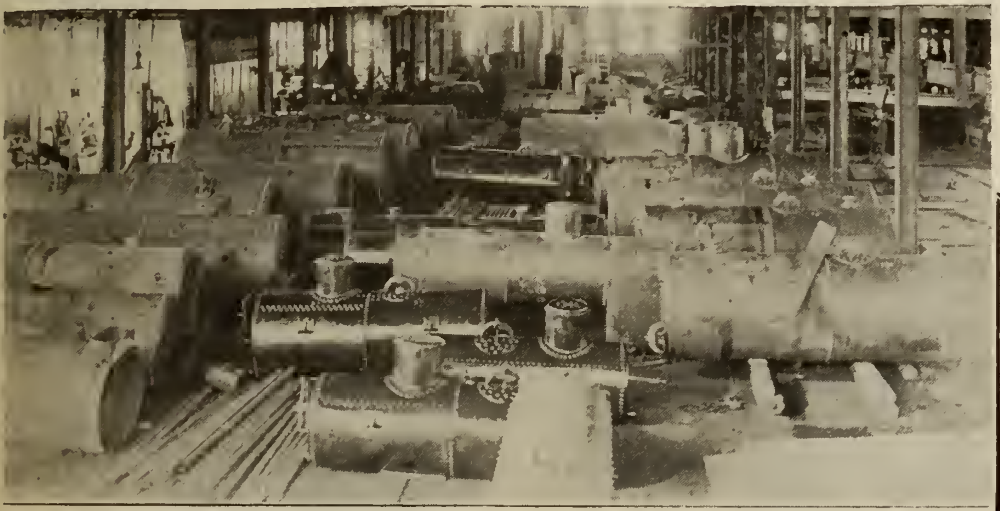
with a record of increasing the lubrication efficiency and lowering the cost.

ALBANY GREASE

should be used in your plant all of the time. Write us for testing samples.

Your dealer sells Albany Grease ; if not, order direct

Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868



JENCKES BOILERS

Deliver a service that gives you fullest satisfaction.

The Jenckes Machine Co., Limited

Sherbrooke, Montreal, St. Catharines, Toronto, Cobalt, South Porcupine, Nelson, Vancouver.

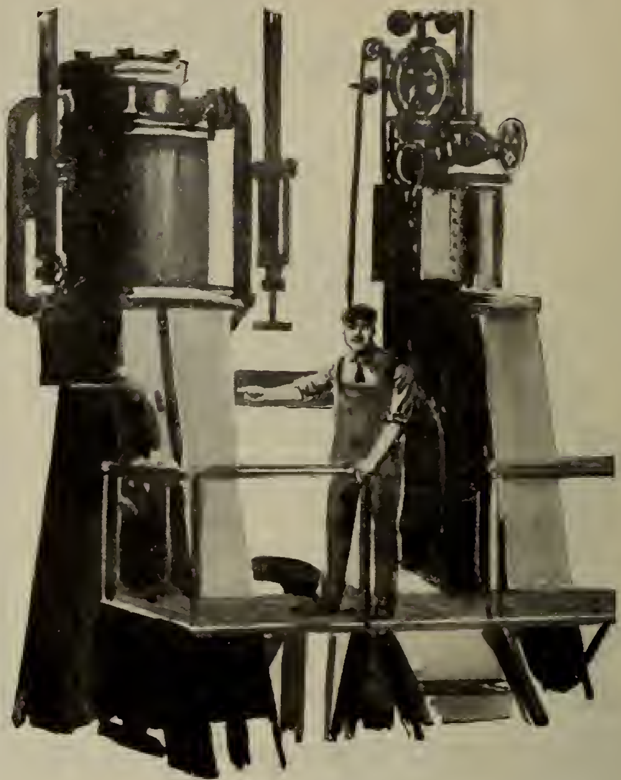
Works :— SHERBROOKE, QUE., and St. Catharines, Ont.

They minimize repairs, and are constructed for long life and hard service.

Made in Horizontal Tubular, Vertical Tubular Locomotive and Heating Boiler Types. All sizes to any provincial act.

PROMPT SHIPMENT.

"Now I Know the Truth About Ammonia Packing"



When you decided on the Ammonia Rod Packing to use last year, naturally you supposed the kind you selected was the best. But, now, when you know what that packing did, or didn't do, what is your opinion?

How much ammonia, do you think, was wasted? Didn't you do a lot of unnecessary work, repacking or tinkering with packing that one part of the time was too tight, and too loose the other?

DANIEL'S ROD PACKING P.P.P. FOR AMMONIA PURPOSES

Reg. U. S. Pat. Off.

P. P. P. is the ONLY packing made that AUTOMATICALLY regulates the bearing on the rod to the requirement.

P. P. P. is the ONLY packing that can, itself, change the adjustment BACK of the oil gland.

P. P. P. is the ONLY packing made that does not create UNNECESSARY FRICTION.

P. P. P. is the ORIGINAL packing with "sliding wedges" and "compressible cushions," and it is the successful packing of this type.

P. P. P. is the packing that ALWAYS makes good.

P. P. P. is the only packing backed with scientific proof that it reduces friction. Long tests by Mechanical Engineers proved that P. P. P. saved 75% or more friction.

Put Your Problem Up to Us

As the various types of ice machine stuffing boxes create such widely differing conditions that no set rule can be laid down, we advise that you write us, giving make of machine, size of stuffing boxes, etc. If possible, send sketches or blue prints of the boxes.

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS

PHILADELPHIA, PA., U.S.A.

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

JOHNS-MANVILLE SERVICE

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

THE statements made for J-M Products are more than claims—they are *established facts.* They can be investigated from top to bottom, and will be found to be as honest as the goods themselves. For J-M takes pride in its output and has backed it with J-M Service and Responsibility. Over half a century in the field, and the modern manufacturing facilities, have put J-M Products where they are to-day—the *standards* of their kind.

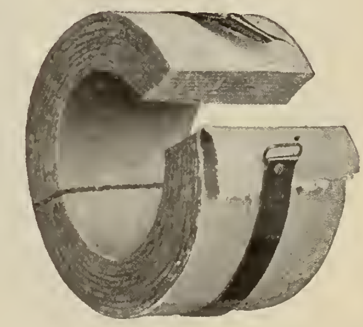
40% more steam available with the same amount of coal, why—J-M Heat Installation

(Actual Case)

"Does it pay to use an insulation?"—this is the question that comes to the executive seeking the greatest efficiency from his steam plant and to the steam engineer who wants to show the greatest return for the amount of coal burned.

We asked the Chief Engineer of a large plant this question. And his answer was—"At the same time that I installed J-M Heat Insulation throughout this plant, I added apparatus that called for 40% more power. But we are generating no more steam than before the addition to the plant was made."

And this is but one of the many cases where a saving has been remarked. It is but one of the thousands of actual cases where J-M Heat Insulation has helped a plant. Helped with its 21 kinds of insulation, its corps of service men who get together with you to plan the job and who install it for you if you so desire. Why not let it start work in your plant?



J-M Asbesto-Sponge Felted.—One Style of J-M Heat Insulation

Look into the J-M Steam Trap

What do you see? Just the Ball. That's all. No lever, diaphragm or valve. Nothing to bind—nothing to break. Can't get out of order. Notice how heavy the flanges and body are. Made extra strong to stand extra strains.

The J-M Trap will discharge water and air as fast as collected without loss of steam. The Ball is simply rolled from its seating by the water. Air as well as water is instantly discharged. The Ball then rolls back onto its seat. This rolling action distributes wear over entire surface of ball, rendering wear at any point so slight as to make trap practically everlasting without repairs.

Made in all sizes for all pressures. Highly efficient on grease and oil separators and for vacuum systems.

Special Steam Trap Bulletin sent on request. Write for it.

The Canadian H. W. JOHNS-MANVILLE CO., Limited

TORONTO MONTREAL WINNIPEG VANCOUVER

638

–runs like a charm

IT CUTS attention to a minimum and its grip on the pulley practically eliminates slippage.

And this good service goes on and on for years because our experience and care in selecting hides, and our **Genuine British Oak Method of Tanning** makes a belt that is exceedingly tough and durable.

More solid belting to the foot than in any other belting made.

This is a belting with a fine record of service behind it—ask the user. Many of Canada's largest power plants are our steady customers.

Let us fill your next belting requirements—and you'll be sure to come back for more.

VANCOUVER, B.C.
847 Beatty St.

Engineers' Supply Company
123 Bannatyne Ave. E.
WINNIPEG, MAN.

D·K·McLAREN
LIMITED

TORONTO, ONT.
200 King St. West

ST. JOHN, N.B.
64 Prince William St.

Head Office and Factory:
351 ST. JAMES STREET, MONTREAL, P.Q.

Garlock

Pump

Valves

The service of pump valves depends upon the compounds as well as the consistency and cure of the valves. The compounds used in Garlock pump valves have been established after years of trial in actual service and under the most severe conditions. Pump valves should always be used for the purposes for which they are intended. The following are a few of our leading styles and grades of valves:

Style No. 139—For medium pressure cold water.
" " 175—For high pressure cold water.
" " 182—For warm or greasy water.
" " 108—For hot water.
" " 105—For boiling water.
" " 154—For air compressors and condensers.

We guarantee our pump valves to give satisfactory service when used under conditions for which they are intended.

THE GARLOCK PACKING COMPANY

HAMILTON, ONTARIO

BRANCHES:

Montreal, Quebec - - 342 St. James St. East
Toronto, Ontario - - 404 Continental Life Building.
Winnipeg, Manitoba - - - Galt Building.

Consider the Convenience of Packing

ANY SIZE VALVE

from one spool of

TRADE MARK
"PALMETTO" TWIST PACKING
REG U S PAT OFFICE

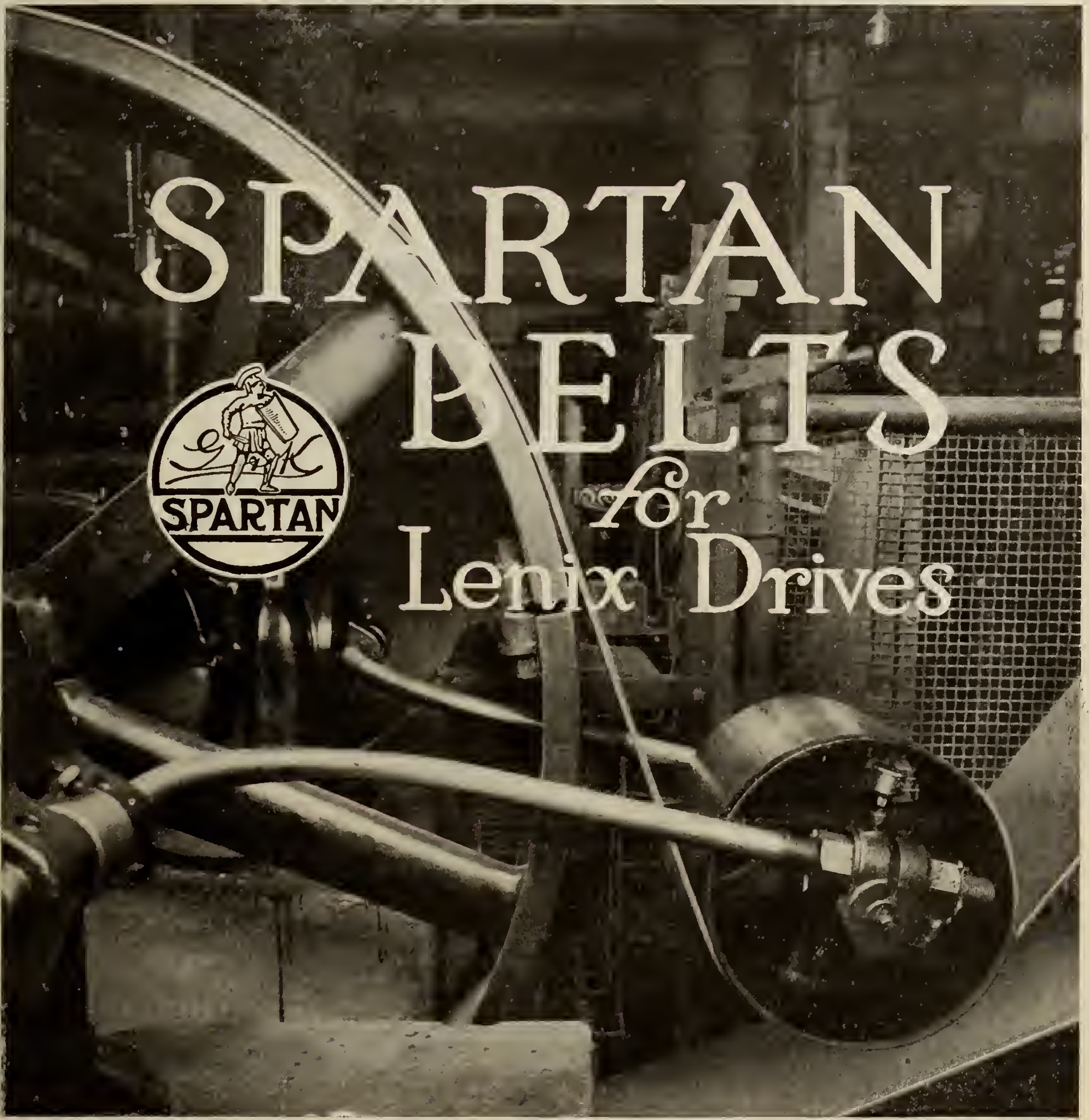
(you just unstrand to the desired size) and at the same time you know the valve will remain tight.

It's the lubricant in each strand of high tensile strength that gives "Palmetto" the long life in service.

Let us send you a sample spool (no charge) and it will convince you that "Palmetto" Packing is what you need.

GREENE, TWEED & CO.
109 Duane St., SOLE MANUFACTURERS New York

Canadian Distributing Agents:
The CANADIAN FAIRBANKS-MORSE CO., LIMITED
Montreal, Ottawa, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Victoria, Vancouver



HERE is a 10-inch Spartan Double Belt driving an air compressor in the engine room of the Norton Company, Worcester, Mass.

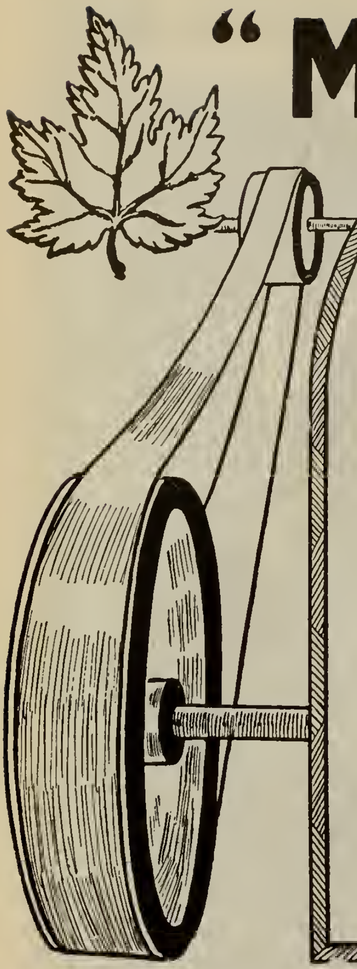
The belt operates at a speed of 2,350 F. P. M. from a 10" motor pulley of 900 R. P. M., under a 12" Lenix Idler, to a 54" pulley on the compressor—only 6-foot pulley centers, and transmitting 75 H.P. Furthermore, the compressor is equipped with an automatic starting and stopping device, which naturally subjects the belt to an intermittent load—jumping instantly from no load to full load.

NORTON'S CHIEF ENGINEER STATES: "We have done absolutely nothing to the belt since installed; it is giving perfect satisfaction." Spartan proved particularly efficient because of its unusual strength, great pliability, and pulley grip, which enable the belting to transmit power with great economy.

Spartan Belting is equally efficient for use wherever conditions are unusual and difficult.
Let us demonstrate why it is THE BELT for your requirements.

THE GRATON & KNIGHT MFG. CO., OAK LEATHER TANNERS AND BELT MAKERS
Worcester, Mass., U.S.A.

Representatives in Canada—THE CANADIAN FAIRBANKS-MORSE CO., LIMITED
St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria



"MAPLE LEAF"

Stitched Cotton Duck

Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.

A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

Numidian Cylinder Oil

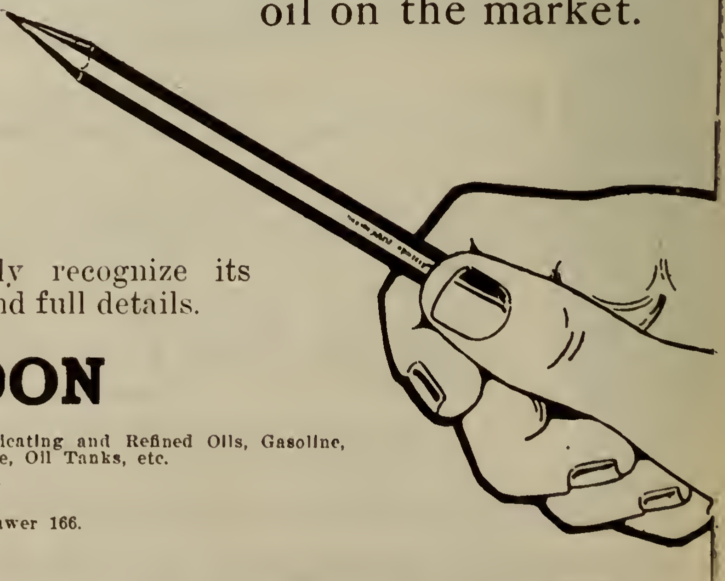
Is the World's Greatest Steam Cylinder Oil

It goes farther and gives greater efficiency than any other oil on the market.

Put it to the test and you'll quickly recognize its superiority. Drop us a line for prices and full details.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.
Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984.
Vancouver—823 Powell Street.
Calgary—1810-1840 Eleventh St. East, P.O. Box 1384, P.O. Drawer 166.
Edmonton—Cor. 13th Ave. and 83rd St., P.O. Box 977.



The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

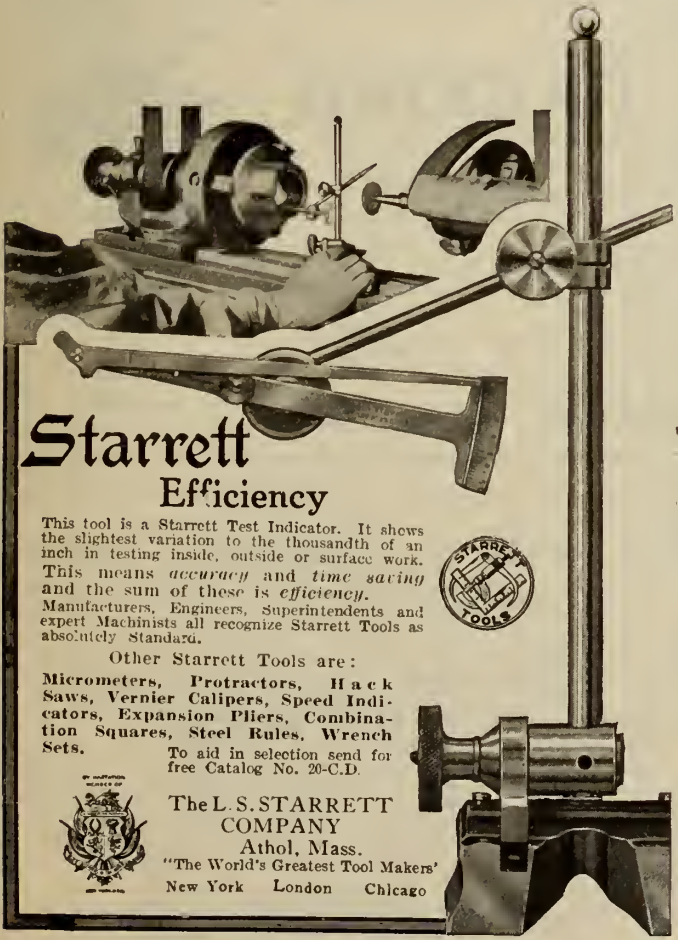
The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union
Roxbury (Boston) Mass., U.S.A.



Starrett Efficiency

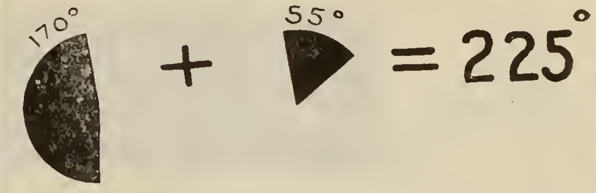
This tool is a Starrett Test Indicator. It shows the slightest variation to the thousandth of an inch in testing inside, outside or surface work. This means *accuracy* and *time saving* and the sum of these is *efficiency*. Manufacturers, Engineers, Superintendents and expert Machinists all recognize Starrett Tools as absolutely Standard.

Other Starrett Tools are:

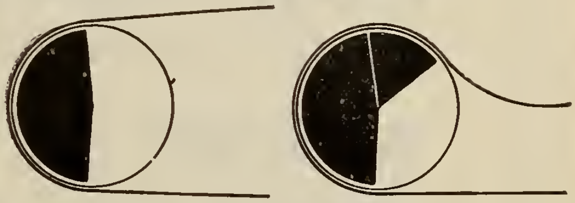
Micrometers, Protractors, Hack Saws, Vernier Calipers, Speed Indicators, Expansion Pliers, Combination Squares, Steel Rules, Wrench Sets.

To aid in selection send for free Catalog No. 20-C.D.

The L. S. STARRETT COMPANY
Athol, Mass.
"The World's Greatest Tool Makers"
New York London Chicago



In other words this belt has (55÷170) 32.3 *per cent INCREASED PULLING ARC due to CLING-SURFACE TREATMENT*



Without Cling-Surface *With Cling-Surface*

These diagrams illustrate nicely how Cling-Surface first stops slip. This permits the belt to be run slack without the necessity for tightening. Hence the greatly increased arc of belt contact as shown above.

Cling-Surface-treated belts become impervious to moisture and steam and are not dried out by heat.

The application is very simple and the cost only a few cents per belt per year.

We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

Cling-Surface Co

1057 Niagara Street
Buffalo, N.Y.

I am interested in Cling-Surface and your trial order proposition.

Name ....Position ....
Firm ....
Street ....
City ....Province ....

92

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

TRADE MARK

TRADE MARK

FOR PULP GRINDING

Steep Falls, Maine, March 22, 1915.

Gentlemen,—We are using your Magnolia Anti-Friction Metal in some of the most important bearings we have, such as our Baker & Shevlin centrifugal screws running at a speed of 550 R.P.M. and screening 25 tons air dry pulp daily; our Bagley & Sewall 6" fan pumps, two of these are lifting to a height of 85 to 90 feet; our Deane Triplex Pump, which supplies us our pressure for our grinders under 12 ft. lift and furnishing 45 to 60 lbs. at grinders.

We are using it under every condition in bearings of all sizes and find it an excellent metal under our conditions.

Yours very truly,

C. L. Shaw, Supt.,

Androscoggin Pulp Co.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c. post paid.

Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

OFFICE AND FACTORY:

225 St. Ambroise St. MONTREAL

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for **FREE SAMPLE** and particulars.

MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless

Any Quantity sent on APPROVAL

"The Pioneer American Condenser Builders"

29 Inches with a Cooling Tower

An installation comprising a Wheeler-Balcke Natural Draft Cooling Tower (illustrated), a Wheeler High Vacuum Surface Condenser with Wheeler Turbo Air Pump, gave a vacuum of 29 inches and over under winter atmospheric conditions last year.

This remarkable performance sets a new record for condensers operating with artificially recooled circulating water. It is better than the vacuum obtained in some plants having a natural supply of cold water. With a

WHEELER EQUIPMENT

you can operate condensing and maintain vacuums from 27 to 29 inches the year around, even when a natural supply of cooling water is not available.

We build all types of towers of all sizes, and can recommend the equipment best suited to your plant conditions. Our experience embraces all the important cooling tower and condenser installations made in recent years in this country. If interested send for our Bulletins on Wheeler-Balcke Towers, Wheeler-Barnard Towers Wheeler Condensers and Wheeler Turbo Air Pumps.

WHEELER CONDENSER & ENGINEERING COMPANY,
CARTERET, NEW JERSEY

132

Just because you have always used belt drives for certain applications of power, is no reason why you should continue to do so.

Send for your choice of the first two publications in our "A CHAIN OF EVIDENCE" series—No. 13, Textile Mills; No. 14, Large Power Drives.

THIS logic applies also to the use of gearing and ropes.

Modern progress has come about by attention to small details, just as the saving of pennies takes care of the dollars.

Silent chain transmission, in broad commercial use since the inception of the electric motor, has come to stay.

It is not a cure-all to be used indiscriminately in each and every case, but in most cases where its application is practical from an engineering standpoint it affords a transmission superior in every way to the older systems.

Greatest sustained efficiency, minimum repair and maintenance costs, ease of application, quietness, etc., etc., are some of the features you can look forward to in the selection of MORSE Silent Chains, all of which means greater economy in transmitting your power than heretofore possible.

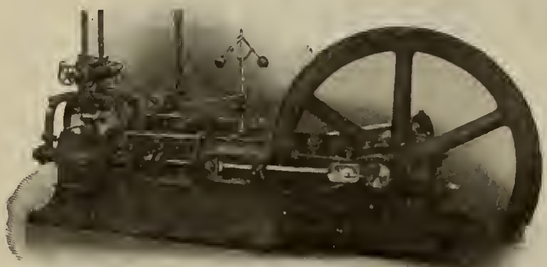
We should be glad of an opportunity to explain in detail.

Morse Chain Company, **General Office and Works, Ithaca, N. Y.**

New York - - 50 Church St.
Boston - - - - 141 Milk St.
Chicago - Merchants L. & T. Bldg.
Pittsburgh - Westinghouse Bldg.
Cleveland - 421 Engineers Bldg.
Detroit - - 1003 Woodward Ave.
San Francisco - Monadnock Bldg.

ST. LOUIS, Morse Engineering Co., Chemical Building.
MINNEAPOLIS, Strong-Scott Mfg. Co., 413 Third Street, S.
ATLANTA, Earl F. Scott, M.E., 702 Candler Building.
GREENSBORO, N.C., G. W. Pritchett, 805 Ashboro St.
Licensees for Europe: The Westinghouse Brake Co., Ltd., 32 York Road, King's Cross, London, N.

W-10



Vilter Refrigerating and Ice-Making Equipment

is recognized as standard throughout the world. Our product is built in all sizes and capacities, suitable for every service to which refrigeration is applied. Write us for an estimate covering your requirements.

BULLETINS SENT ON REQUEST

THE VILTER MFG. COMPANY
242 BECHER ST. MILWAUKEE, WIS.

York Enclosed Refrigerating Machine
(Latest Type)

Looks **good**.

Is **good**.

Will prove a **good** investment for you.

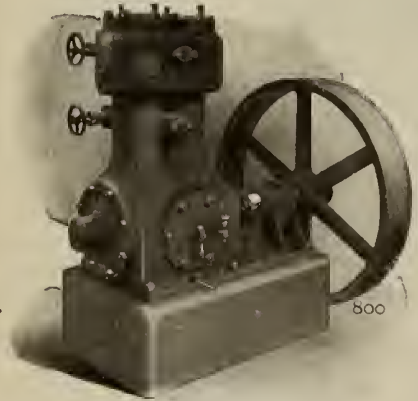
Compressor, Frame, Bedplate, and Outboard Bearing cast in one piece—the most rigid construction.

Completely machined at one setting — by special machinery—securing ABSOLUTE ALIGNMENT of SHAFT with COMPRESSOR.

The YORK Organization is credited with 40% of the annual sales of Refrigerating Machinery in this country. Let us tell you why.

Enclosed Machines ⅛-ton refrigerating capacity upwards. Price on application.

York Manufacturing Company
(Ice-Making and Refrigerating Machinery exclusively)
YORK, PA., U. S. A.



Represented in the Dominion by

CANADIAN ICE MACHINE COMPANY

TORONTO, 82 Chestnut Street
MONTREAL, 227 Coristine Building
WINNIPEG, 85 Lombard Street

QUALITY

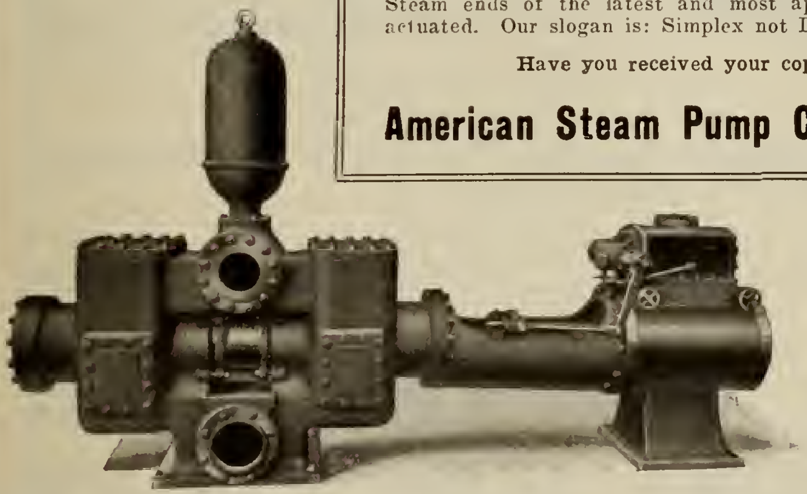
Is always present in

"AMERICAN" STEAM and POWER DRIVEN PUMPS

They are the result of over twenty-five years' experience in the design and construction of high-grade pumping machinery. Note the heavy, solid construction. Solid bronze piston rods and heavy cast bronze removable water cylinder bushings. Steam ends of the latest and most approved balanced piston type, mechanically actuated. Our slogan is: Simplex not Duplex, "To be simple is to be great."

Have you received your copy of our new Bulletin Catalog?

American Steam Pump Co., Battle Creek, Michigan



CANADIAN AGENTS:

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.

J. V. Jamison, Pres. **T. B. South, Vice-Pres.**
J. V. Jamison, Jr., Sec. & Treas.
R. L. Jamison, Order & Ship. Dep't.

Cold Storage and Freezer Doors either Standard or Fireproof

DOORS

"Jones" Standard Automatic Track Door, Left Hand.

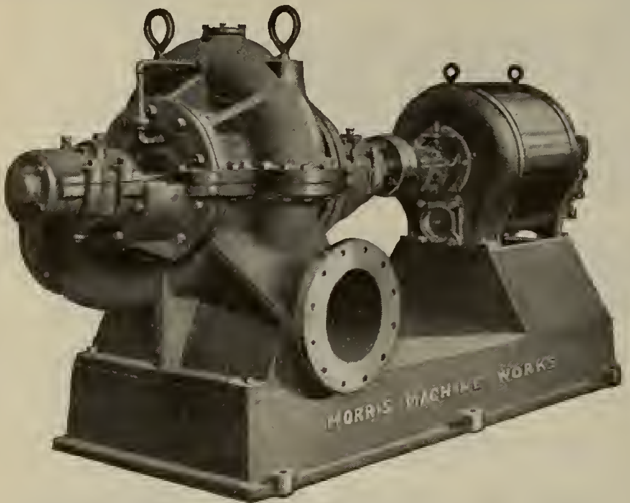
The "Jones" Door, with double seals of contact between the Door and Frame, is the heaviest constructed, most durable and best insulated Door made. Proof—Compare catalogued weights and detail sectional views, or ask P. Burns & Co., Gordon, Ironsides & Fares Co., Canadian Fish & C. S. Co., Prince Rupert; Frontenac Brewing Co., Montreal, Quebec, Canada; Canadian Government Agricultural Dept., or any other large users of Doors of National or International importance. Most of them say "the Door that gives us the least trouble is the 'Jones.'" Built for strength and durability.

We have a new 96-page illustrated catalogued treatise on Insulated Doors. The most complete ever issued, free for the asking. It describes, in addition to the above:

The "Jones" Cold Storage Window.
The "Jones" Automatic Ice Recording Doors and Chutes.
The "Jones" Platform Ice Passing Chute and Door combined.
The "Noequal" All Steel Automatic Ice Chute.
The "Noequal" Revolving Ice Cream Passing Door (Wood or Steel)
The "Jones" Vertical Sliding Door.

Jamison Cold Storage Door Co.
Formerly JONES COLD STORE DOOR CO.
HAGERSTOWN - MARYLAND, U.S.A.

If what you want is not advertised in this issue consult the Buyers' Directory at the back.



Accessible Pumps

The "Morris" Horizontally Split Shell Centrifugal Pump is very popular with pump users — can be inspected quickly without breaking pipe connections.

THE LATEST UP-TO-DATE DESIGN BACKED BY HALF A CENTURY'S PUMP EXPERIENCE

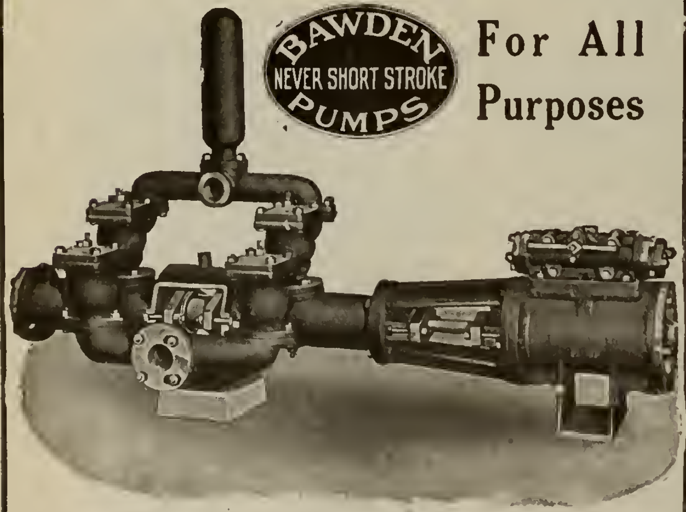
The cut shows a steam turbine driven pump, the same design being used for motor and other drives. We build centrifugal pumps for all services, including BOILER FEEDING, TANK PUMPING, GENERAL WATER SUPPLY, BRINE WORK, ETC. Send us your inquiries for pumps of all types.

STOREY PUMP & EQUIPMENT CO., KENT BUILDING, TORONTO, CAN.
Canadian Sales Agents for
MORRIS MACHINE WORKS, BALDWINSVILLE, N.Y.

Bawden Pumps

BAWDEN
NEVER SHORT STROKE
PUMPS

For All Purposes



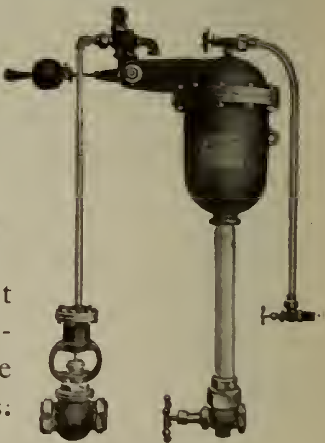
The pumps backed by a grand reputation and the finest installation in Canada.

BAWDEN BASKET STRAINERS AND PIPE FLANGES

The Bawden Machine Co., Ltd.
133 Sterling Road, Toronto, Canada

The VIGILANT Feed Water Regulator

is simple because it is apparent and contains no invisible operating features:



NO "GUESS" IT'S WORKING

All the working parts of the Vigilant Feed Water Regulator are out in plain view, where the attendant can see them move. He does not have to "guess" his feed water regulator is working, but can see it do so. This creates an interest in the machine, and breeds a feeling of confidence. It is human to neglect what is not in sight. Both the motion of the counter weight and the weight lever tell the operator whether the machine is feeding or not. This is another reason why you should own a Vigilant. **Why not get the best regulator?**

Write for Catalogue.

THE CHAPLIN-FULTON MFG. CO.
28-34 Penn Ave., Pittsburgh, Pa.
Sole Agents for Province of Quebec:
R. E. Cleaton Co., 20 St. Nicholas Street, Montreal

The advertiser would like to know where you saw his advertisement—tell him.

An 'Economy' for every use

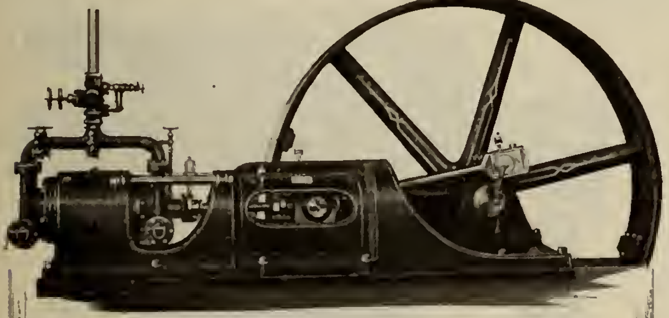
Kerr 'Economy' Steam Turbines

High-pressure, non-condensing or bleeder turbines, from which exhaust can be used for heating purposes. High Pressure Condensing Turbines for minimum steam consumption. Low and mixed pressure turbines for operation on exhaust steam from other sources, otherwise wasted.

Connected direct or through highly accurate and efficient "Economy" Herringbone Reduction Gears to generators, pumps, blowers, etc., and for belt or rope drive.

KERR TURBINE COMPANY
WELLSVILLE NEW YORK, U.S.A.

Offices in Montreal, Toronto, Winnipeg, Vancouver and all large cities in the United States.



When you are in the market for a high-class ice-making or refrigerating plant, do not overlook the service and equipment which we have to offer. It is worth your careful investigation. *Your inquiry will be appreciated.*

THE HUETTEMAN & CRAMER COMPANY
Manufacturers of
Ice-Making and Refrigerating Machinery
DETROIT, 43rd Year. MICHIGAN, U.S.A.

Read Our New Book On

Centrifugal Blowers and Compressors

OUR policy of making overall steam consumption guarantees on all De Laval steam-turbine-driven apparatus, including centrifugal blowers and compressors, is helping to introduce high efficiency fans and blowers. It pays in the long run to buy De Laval units, because of greater overall economy.

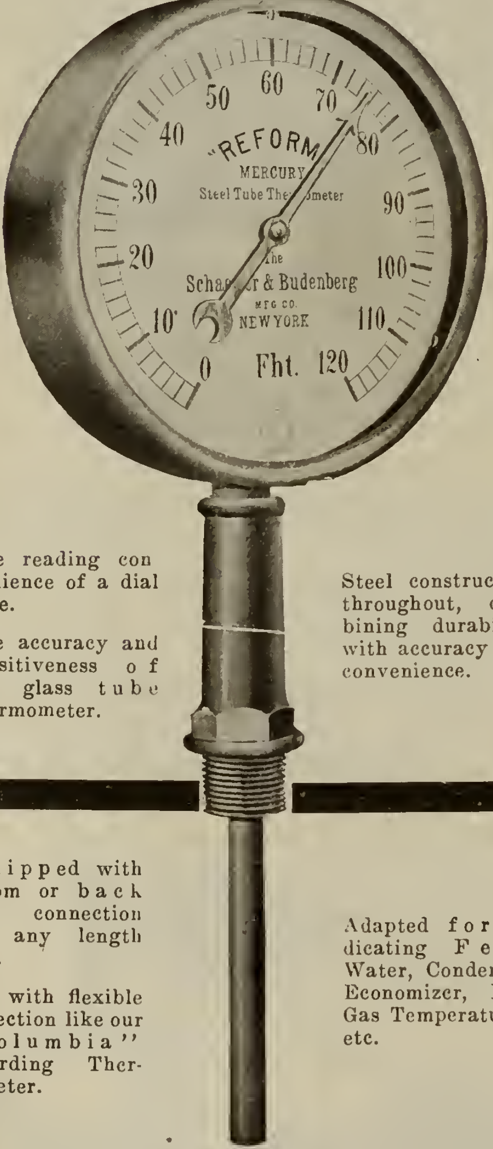
DE LAVAL centrifugal blowers and compressors for all volumes and for all pressures from 5 inch water column for mechanical draft, up to 125 lb. per square inch, are built in the same shops, by the same methods and from the same high grade materials that have been responsible for the high reputation of our other products.

OUR Catalog F61 on Centrifugal blowers and Compressors treats of characteristics and application of such apparatus.

De Laval Steam Turbine Co.

TURBINE EQUIPMENT CO., LIMITED
Canadian Pacific Bldg. TORONTO, Canada
THE E. LAURIE CO.
243 Bleury St. MONTREAL, Que.
202

"REFORM"
Mercury Actuated Dial Thermometer



The reading convenience of a dial face.

The accuracy and sensitiveness of the glass tube thermometer.

Steel construction throughout, combining durability with accuracy and convenience.

Equipped with bottom or back rigid connection and any length stem.

Also with flexible connection like our "Columbia" Recording Thermometer.

Adapted for indicating Feed Water, Condenser, Economizer, Flue Gas Temperatures, etc.

Ask for Pamphlet W-101

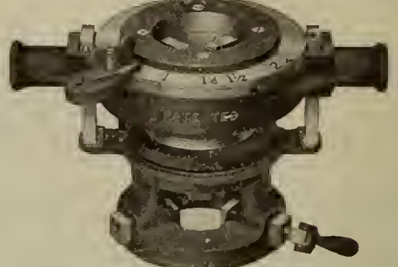
THE Schaeffer & Budenberg MFG. CO.

Makers of "Columbia" Recorders, "Crescent" Thermometers, S & B Gauges, Tachometers; Counters, Calorimeters, Indicators, etc.

Berry and South 5th Streets, Brooklyn, N. Y.
Also Chicago, Philadelphia, Pittsburgh.

RAPID WORKERS

BEAVER TOOLS



"BEAVER" DIE STOCKS

Cut right or left hand thread. Sizes 1/8 to 8 inches diameter.

"BEAVER SQUARE END PIPE CUTTERS"

Will cut pipe 1/8 to 6 inches diameter.

Booklet and Prices on request.

WRITE NOW.

BORDEN-CANADIAN COMPANY
66 Richmond St. East, Toronto, Ont.

OSTER BULL DOG No. 104

Six sizes—one tool

Easily-cut, clean-cut threads on pipe from 1/2" to 2" in size. That is the story of this tool, Oster Bulldog No. 104. All of the 11 sizes have the 5 big Oster features which are described in detail in our illustrated booklet, "The Bulldog Tale." Send this coupon for your copy.

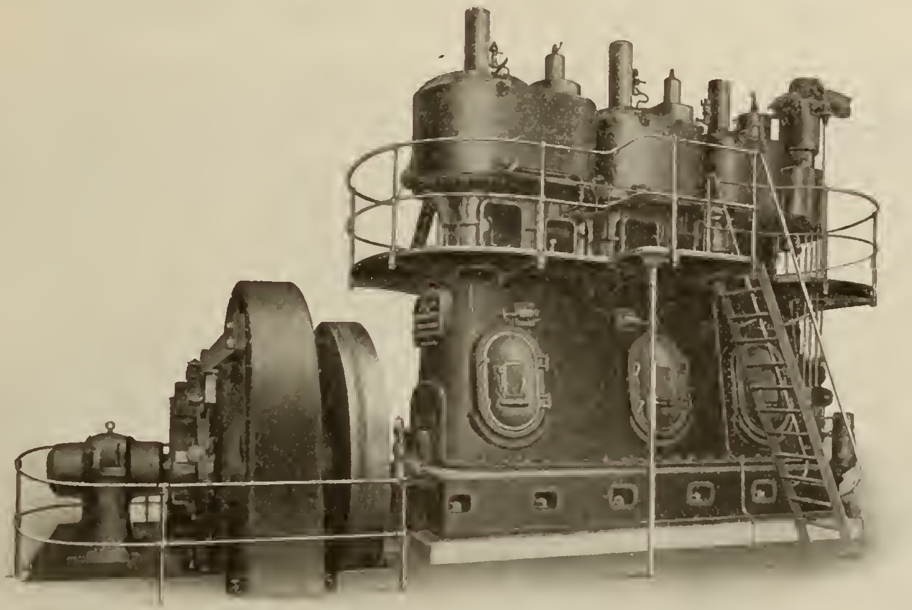
THE OSTER MFG. CO.
2099 E. 61st St.
CLEVELAND, OHIO

Kindly send me the illustrated booklet, "The Bulldog Tale."
Name ....
Company ....
Address ....
City .... Prov ....
(2000)

OSTER-CUT THREADS

The advertiser would like to know where you saw his advertisement—tell him.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



1500 Kilowatt Belliss & Morcom High Speed Engine

SEND US YOUR ENQUIRIES FOR

DIESEL ENGINES

Steam Engines	Boiler Feed Pumps
Condensing Plants	Producer Gas Engines
Air Compressors	Oil Engines
Steam Turbines	V-notch Water Meters

Complete Power Plant Equipment

We can offer a large assortment of machinery for immediate shipment.

LAURIE & LAMB

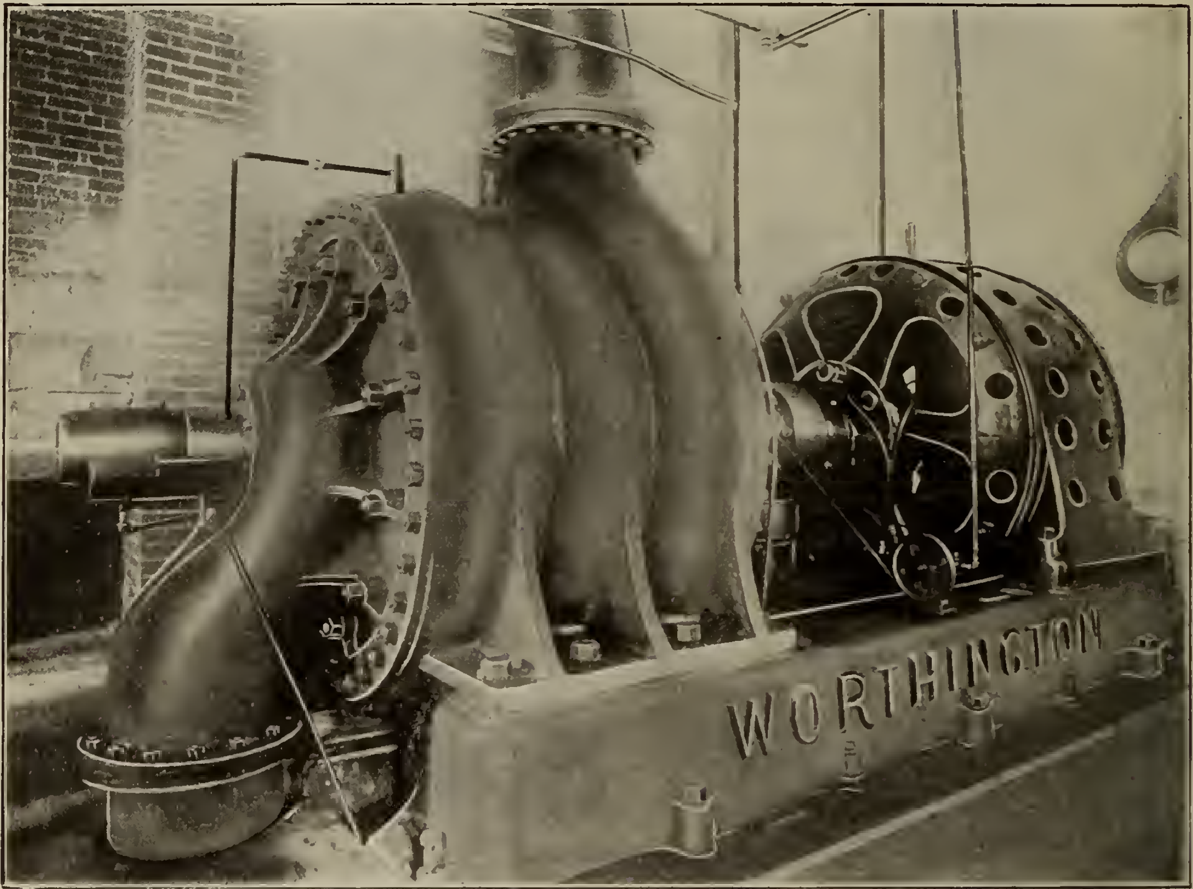
Engineers

211 Board of Trade Bldg. :-: :-: MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps—centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

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The Publisher's Page

By B.G.N.

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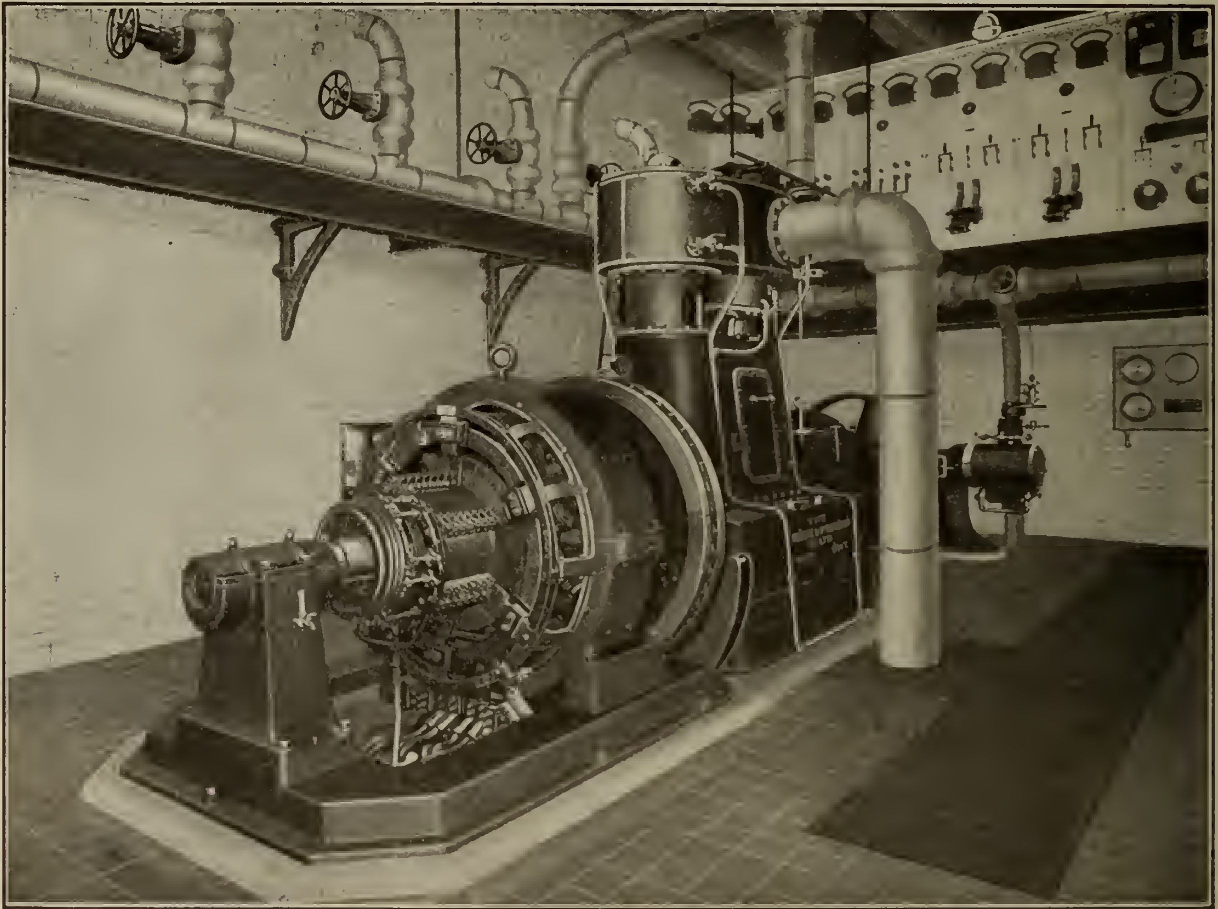

Illustration shows a portion of the Engine Room in connection with the new Toronto Technical School, which is equipped with G. & McC. Vertical Steam Engine of 250 K.W. capacity, and also an Ideal High Speed Steam Engine of 50 K.W. capacity. In addition to these we are supplying a small 15 H.P. Steam Turbine for experimental purposes.

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NEW CENTRAL TECHNICAL SCHOOL

TORONTO, ONT.

Staff Article

The year 1915-16 will be memorable in the annals of technical education in Canada. The additional facilities afforded by the new building were expected to be more than ample, but the excellence of the arrangement has so increased the demand for tuition that overflow attendances in all departments have taxed the new institution to the limits of its capacity.

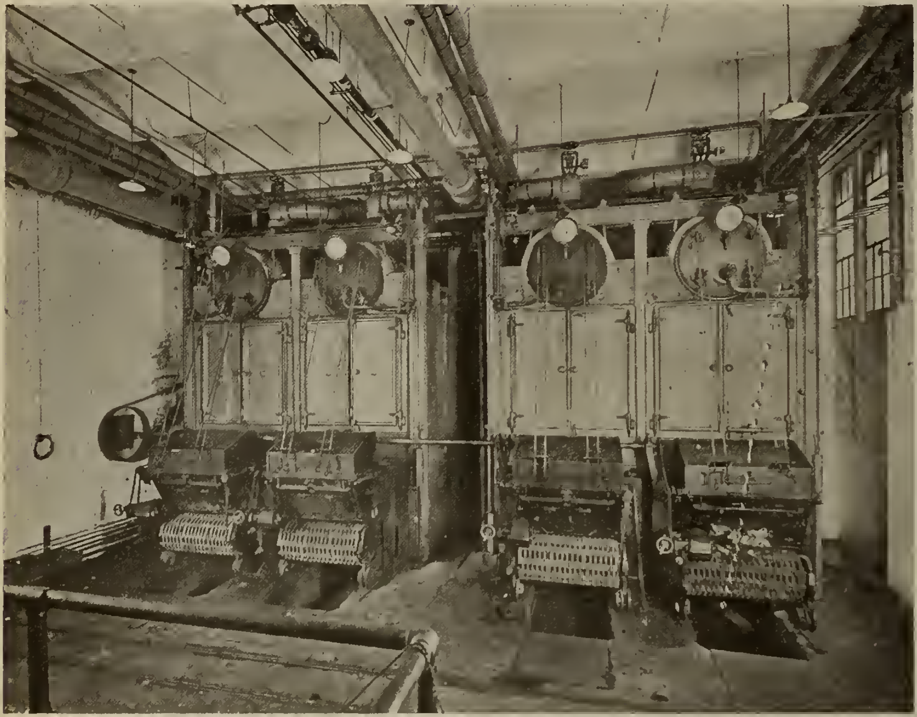
THE engineering department of the new Toronto Technical School comprises the entire power plant, heating and ventilating system, air compressor plant, refrigeration plant, elevators, hot water service system, the various auxiliaries and the experimental engine laboratory. The engineering department is one of the most important in any technical school, and in this case no expense has been spared in getting the best equipment and installing it to the best possible advantage to meet the requirements of an institution of the kind. The power plant, for instance, in addition to furnishing light, heat, etc., for the building, can also be turned to good account for the benefit of the students, although primarily it is intended for the former service.

The various requirements that had to be considered in the layout of the plant may be briefly summarized as follows: To provide light, heat and power for both day and night use independent of outside power, but at the same time to operate in conjunction with it if necessary; to include in the plant such an assortment of equipment and apparatus as to give the student an opportunity of familiarizing himself with various makes and designs which he might encounter in his future career; to distribute and supply electricity, compressed air, hot and cold water, to all the shops and laboratories for the benefit of the students; to provide good heating and ventilation and an adequate supply of hot and cold water for the lavatories and swimming tank; to have a plant that could be used for demonstration purposes for students, and at the same time used for ordinary purposes without loss of efficiency. That the foregoing ideals have been in large measure accomplished will be apparent from what follows:—

A. C. McKAY, B.A., LL.D.,
Principal of New Technical School.

The power plant is located in the sub-basement 25 feet below the basement floor, and 30 feet below the street level. The sub-basement floor is 16 feet below the sewer, and is divided into three main sections, boiler room, engine room and fan room. The boiler room is again sub-divided to form the pump room at a slightly higher level. In the boiler room, in addition to the boilers are the coal bunkers, blow-off tanks, and sump with motor-driven pump.

In the pump room are the boiler-feed pumps, circulating pumps on the heating system, feed water heater, live and exhaust steam heaters, service water heater, swimming pool water heater, and filter.



WATER TUBE BOILER INSTALLATION.

The engine room contains a large high-speed engine and generator, a horizontal high-speed unit, a horizontal corliss-valve engine and generator, air compressor, ammonia compressor and motor generator set. On the gallery is the switchboard, while on the same level, but outside the engine room are the operating engineers' room, locker and lunch room for the firemen, several store-rooms shower bath and lavatory. In a small room off the engine room and at the same level is a transformer room and also the refrigerator room containing a tank for making can ice, also drinking water chill and filter. In the fan room are two large ventilating fans with air washers and heaters, a smaller fan for the smith-shop forges, vacuum machine for the chemical and physical laboratories, a vacuum cleaning machine, and temperature regulator equipment. On this floor leading to the fans is a large cold air intake 10 feet high by 25 feet wide.

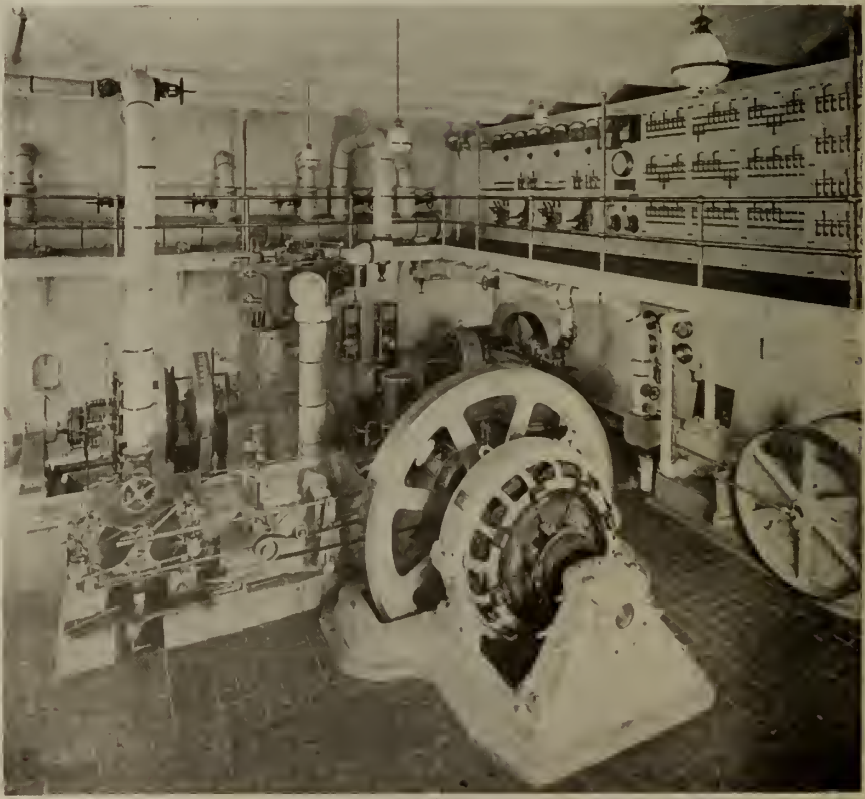
Boiler Installation

The boiler plant consists of four water-tube boilers, arranged in two batteries and having a total horse-power of 720. Each boiler is rated at 180 horse-power, and has a heating surface of 1790 sq. feet. The tubes are 4 in. in diameter and 18 ft. long, arranged in 8-sections wide, and 10-tubes high. Each boiler has one steam drum 42 in. diameter. The boilers are of standard forged steel construction and are built for a working pressure of 200 pounds, but are operated at 150 pounds per sq. inch. They are fitted with superheaters to give 100 to 120 degrees Fahr., and have chain-grate stokers each having a grate area of 35 sq. ft. The boilers and chain-grates were built and installed by the Babcock & Wilcox Co., Montreal and Toronto.

The boilers are suspended from steel girders resting on steel columns on cast iron bases. The flue dampers are operated by hand. The boilers are fitted with B. & W. type mixing valves, by which the temperature of the superheated steam may be controlled. They are also fitted with standard thermometer wells in superheat box. Auxiliary wells are installed in the steam line with steel mercury thermometers having gauges in front of the boiler giving reading of steam and superheat. Each boiler has two 2½-in. McAvity pop safety valves, one 12-in. brass cased steam gauge, one "Turnbull" high and low water alarm, two ¾-in. water gauges fitted with automatic closing valves, one 2-in. diameter stop and check valve, one 2-in. diameter stop valve, etc.

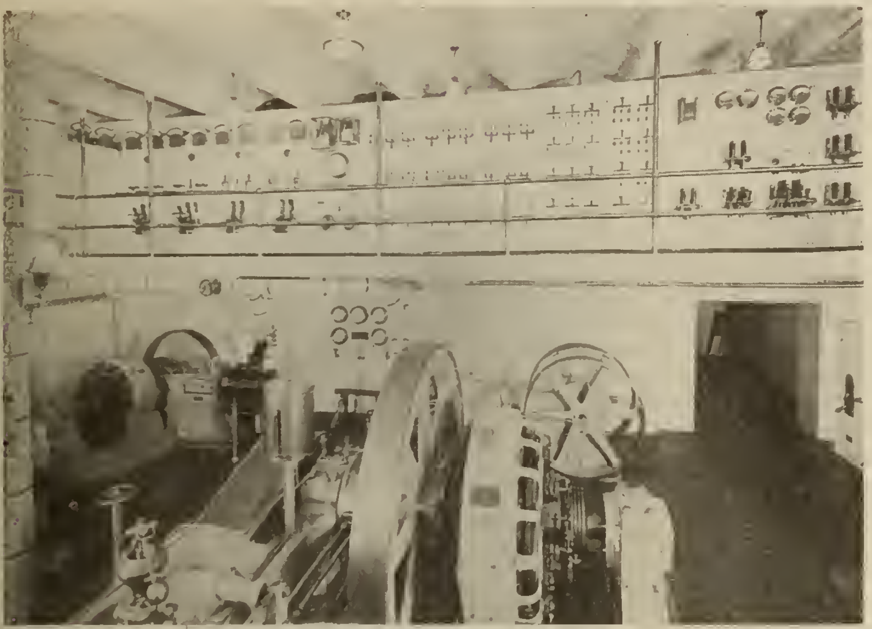
Coal is fed to the grates through hoppers in front of the boilers. Each hopper is provided with a valve for shutting off the supply of coal to the fire and thus controlling the depth of the latter. Doors are provided at the front of the hoppers for hand firing. The stokers are operated by a standard B. & W. vertical enclosed 5½-in. x 5-in. engine, and the coal is carried to the hoppers in a car running on tracks and having a capacity of 1,000 pounds. The coal bunkers are at the side of the boiler room under the sidewalk level. The coal is weighed on a "Dormant" warehouse scale having a capacity of 2,500 pounds and supplied by the Canadian Fairbanks-Morse Co.

Two duplex 7½-in. x 5-in. x 6-in. outside packed plunger pumps, fitted with pot valves, are installed for feeding the



VIEW IN ENGINE ROOM SHOWING ENGINES, GENERATORS AND AIR COMPRESSOR.

boilers. The pumps take water from the "Cochrane" heater to the boilers, and were supplied by the Smart-Turner Co., Hamilton, Ont. For emergency use there is installed a "Metropolitan" injector, single level pattern. The injector is fitted with a by-pass, so that city water can be used direct.



ANOTHER VIEW IN ENGINE ROOM SHOWING HORIZONTAL CORLISS ENGINE AND GENERATOR IN FOREGROUND.

The "Cochrane" feed-water heater is rated at 750 h.p., its exhaust inlet and outlet being 12 in. diameter. The heater is fitted with five gravity return connections from exhaust steam heating system. It has a 6-in. connection for boiler feed and a 3-in. connection for discharging from traps. A pump and receiver are installed for collecting condensate from the live steam heater and returning same to the boilers. The pump is a 6-in. x 4-in. x 7-in. duplex type of "Smart-Turner" make. The outfit is equipped with a "Waters" type of governor valve and float, and water at 250 degrees can be handled. Two "Davis" 5 in. automatic stop and check-valves are fitted in the steam headers, one for the main engines and one for the auxiliary units.

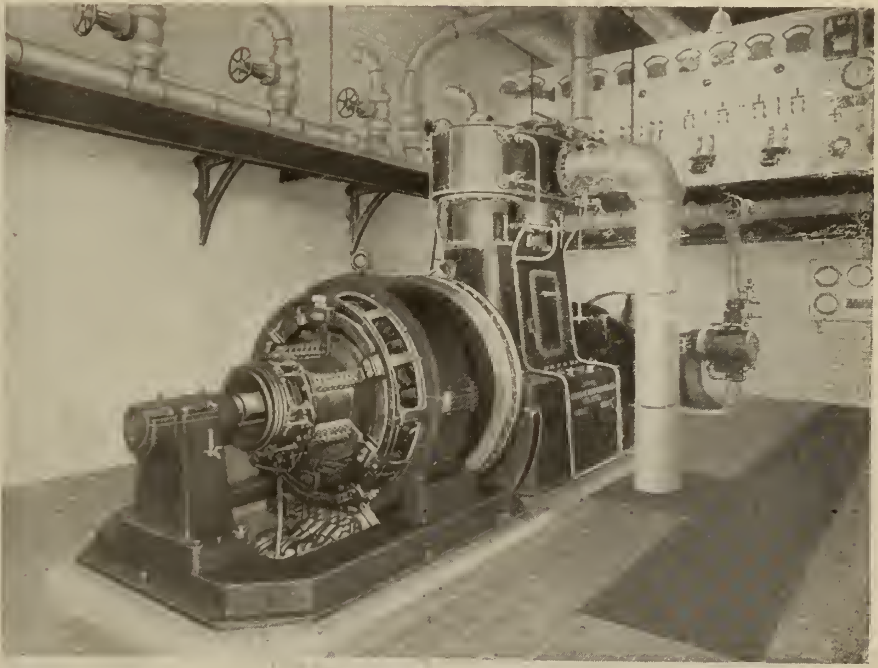
The boiler blow-off tank is located at the rear of the boilers. It is 36 in. in diameter and 48 in. deep, with a 4-in. connection to the boilers and also to the sewer. A 4-in. vapor tube is connected to the tank. This tube leads from the exhaust pipe and allows the steam or vapor to go from the tank to the heating system and also drains water from the steam-line. The exhaust steam main is 12 in. diameter and the main water-line for the heating system is 10 in. diameter.

There are a number of steam traps installed; one "Davis" trap drains the steam headers and all steam heating coils for laundry and dry kilns. A "Davis" trap is also fitted to the service water heater, and the steam connections in the chemistry and physics laboratories are fitted with similar traps. The swimming pool heater is fitted with a trap. All high-pressure traps discharge to the feed water heater, and the exhaust pipe traps discharge to the sump through the blow-off tank.

Engine Room

The engine room has a bright and attractive appearance, the area occupied being 43 feet by 40 feet, and height of ceiling 20 feet. The flooring is of red Welsh tiling, and the side walls of white tile with white enamel finish above; a large mezzanine balcony accommodates the switchboard, and quarters for the engineers lead from same. The units installed are of different types and were selected to show the students the various kinds of machines in use at the present time. The steam plant is more than large enough to develop the necessary power for the motors and lighting systems, etc., but a very favorable rate was obtained from the Toronto Hydro-Electric Commission, so power from this source is largely used. The fact that the plant is larger than absolutely necessary for the power required is accounted for by the necessity of having the various units for demonstration purposes as well as for the actual development of power for the building.

The largest unit is a high-speed compound vertical enclosed, forced-lubrication engine built by the Goldie & McCulloch Co., Galt, Ont. This engine is rated at 365 h.p., and has cylinders 16 in. and 25 in. diameter, by 10 in. stroke. The governor is of the combined throttling and cut-off type. The engine runs non-condensing and is specially designed for superheated steam. The cranks are set opposite to one another, and the reciprocating parts of the high and low pressure sides are carefully checked so that they weigh exactly the same. This arrangement practically balances the reciprocating parts and eliminates vibration at high rotative speed. The engine is direct connected on a common sub-base to a 250 k.w. three-wire d.c., inter-



365 HORSE-POWER, COMPOUND, VERTICAL ENCLOSED, QUICK-REVOLUTION ENGINE WITH FORCED LUBRICATION, AND HORIZONTAL SINGLE CYLINDER, CENTRE CRANK ENGINE, BOTH OF GOLDIE & McCULLOCH MAKE.

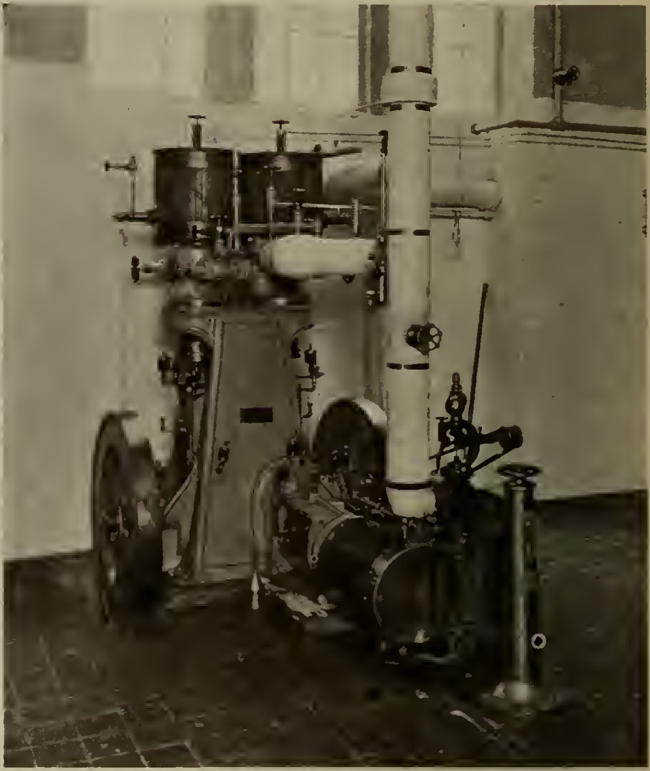
pole generator, built by the Canadian Westinghouse Co.

There is also a horizontal double eccentric corliss engine built by the John Inglis Co., Toronto, Ont. The engine has steam dash pots, is rated at 150 horsepower, and has a cylinder 12 in. diameter by 24 in. stroke. It is direct connected to a 100 k.w., three-wire interpole d.c. generator built by the Canadian Westinghouse Co., Hamilton. The speed is 150 revolutions per minute. A smaller unit showing a type in common use consists of a single cylinder Goldie & McCulloch centre crank 10 in. x 12 in. "Ideal" engine. This runs under the same steam conditions as the other units and is rated at 75 horse-power, when running at 275 r.p.m. It is of the enclosed type with splash oil system, and is direct connected to a Canadian Westinghouse Co. 50 k.w. three-wire d.c. generator.

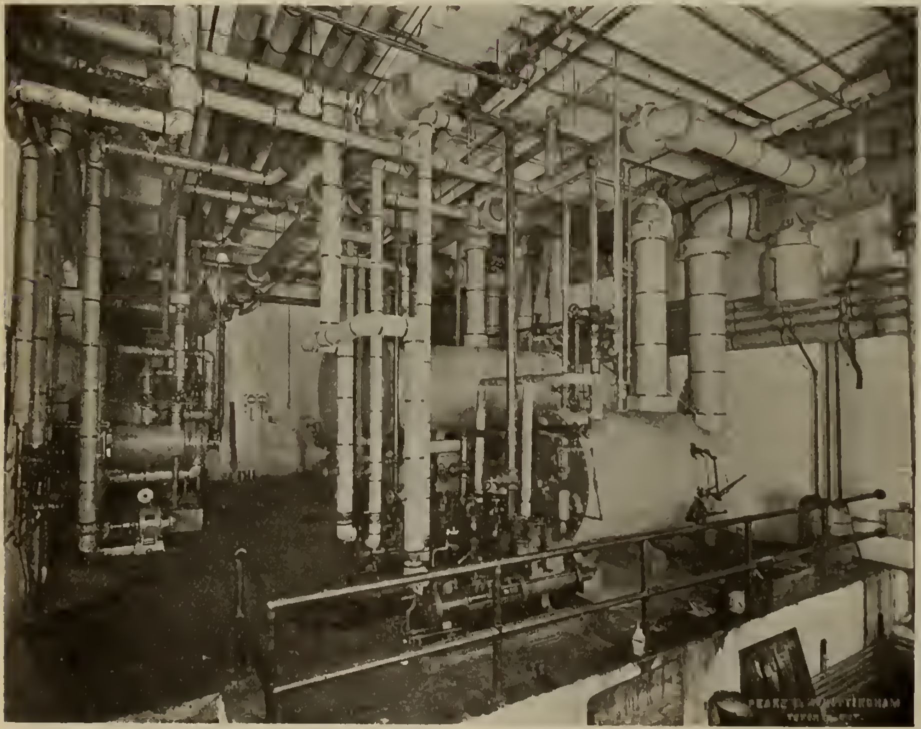
For converting hydro a.c. current to d.c., which is used throughout the building, a Canadian Westinghouse Co. motor generator set is installed. This unit consists of a 125 h.p. three-phase 550 volt, induction motor direct connected to a three-wire d.c., 110-230 volt, 3-wire generator with a capacity of 75 k.w., and running at 800 r.p.m. The starting mechanism for the motor generator is of Canadian Westinghouse Co. make, and is mounted on a white marble panel with an oil immersed auto-switch.

Compressed air for the shops and laboratories and for general use about the plant is supplied by an air compressor built by the Canadian Ingersoll Rand Co., Sherbrooke, Que. This compressor is a 10-in. x 10-in. x 14-in. straight line steam driven machine. It delivers 230 cubic ft. of free air per minute at 100 lbs. per sq. inch, when running at 180 r.p.m. The machine is fitted with an automatic regulator which can be adjusted to obtain any desired pressure. An interesting and somewhat unusual purpose this air compressor is put to is for the swimming pool. Air is blown up through the water in the pool, thus aerating it and driving any scum on top to the channel around the side. The air receiver is 36 in. in diameter, and 72 in. high.

An ice machine is installed in connection with the refrigerator in the Domestic Science Department, for making can ice and for chilling the water supply to the drinking fountains. The ammonia machine has a capacity of 12 tons, and was built by the Frick Co., Waynesboro, Pa. It is a vertical two-cylinder machine, and is direct connected to and driven by a single cylinder horizontal steam engine with "Merze" valve gear. Calcium chloride brine is used, being circulated through the system by a centrifugal pump supplied by the Smart-Turner Co., Hamilton, Ont. The water cooling and can ice plants are in a small room adjoining the engine room. The can ice plant has a capacity of 200 pounds at one pumping.



SINGLE ACTING VERTICAL AMMONIA COMPRESSOR, DIRECT CONNECTED TO HORIZONTAL ENGINE.



GENERAL VIEW IN PUMP ROOM.

Two Venturi meters are installed in the engine room of 3 in. and 10 in. sizes respectively. The former measures the water being used by the boilers and the 10-in. meter measures the water used in the heating system. The majority of the lubricators used in the plant were furnished by the Canadian Detroit Lubricator Co., Walkerville, Ont. The forced feed lubricator on the large Goldie & McCulloch engine was furnished by the McLeod Mfg. Co., Detroit, Mich. The covering for the high pressure pipes was supplied by the Canadian Asbestos Co., Montreal, Que., and is composed of 85 p.c. magnesia, and sectional, in two thickness. Over this is a layer of 8 lb. sheathing paper, and over that again is a covering of 8 oz. canvas. The pipe fittings are covered with 85 p. c. plastic magnesia and the flange joints with removable hinged covers to facilitate inspection. An oil separator is installed in the main exhaust pipe near the "Cochrane" heater.

A 12-in. "Swartwout" exhaust head is fitted to the exhaust stack. It is of cast iron and is fitted with a 2½ in. drain. A 12-in. "Davis" automatic combination back pressure and relief valve is fitted in the base of the exhaust steam stack. A "Simmance-Abady combustion recorder is installed in the engine room. This apparatus is for testing flue gases and was supplied by the Precision Instrument Co., Detroit, Mich. The steam valves are of "Jenkins," "Chapman," and "Lunkenheimer" make. All the steam and hot water piping was supplied and erected by the General Fire Extinguisher Co., Toronto.

Switchboard

The main switchboard, which is an exceptionally fine piece of work is situated on a balcony along one side of the engine room. It was designed by the Canadian Domestic Engineering Co., Toronto, and installed by Keith's, Ltd., Toronto. The switchboard is 42 feet by 8 feet, and was designed to control 3-engine driven generators, one motor generator set and feeder circuits for light and power, both a.c. and d.c. The system is 120 volts d.c., and 3-wire, 550 volts 3-phase, 25 cycles for the a.c. service and branches.

There are 17 panels, Nos. 1 to 11 being for d.c., and 12 to 16 for a.c. service, and one totalling panel. The panels are made of white Italian marble 2 in. thick, each being built in two sections and supported on an angle iron frame work. There are two sets of bus bars, one carrying the current from the generators which are arranged with equalizer connections so that they can be run in parallel. The other set of bus bars carries the current from the motor generator set serving all the lighting and such power as may be required when the engines are not running. Double-throw switches are installed for this service.

There are four generator panels, each being equipped with I.T.E. double pole circuit breakers, a single pole knife switch for the neutral wire and a double pole single throw knife switch for the power wire. Each panel has two "Weston" ammeters and a field rheostat for controlling the voltage of the generators. The totalling panel in the centre of the board has one d.c. graphic recording "Westinghouse" meter for all the generators; one d.c. graphic recording "Westinghouse" watt meter for the motor generator set, and a clock which is connected with the clock system. There is also on this panel an integrating watt-hour meter, also "Westinghouse Columbia" type, 3-wire service for the motor generators. One rotary volt-meter switch is arranged so that the total voltage of any generator can be obtained, or voltage of either outside line and grounded neutral. There are two voltmeters mounted on a swing bracket at the end of the board. One is a single scale instrument connected to the bus bars, and the other a double scale instrument connected to the generators.

There are three light-distributing panels, each having nine triple pole, double throw knife switches. There are also two power-distributing panels. One of the latter has nine single throw triple pole switches and three double throw triple pole switches. The double throw switches control the elevators, machine srop, and some sections of the woodworking shop, so that these can be run by the motor generator or engines. The other power distribution panel has six single throw, triple pole, knife switches and two double throw, triple pole, knife switches.

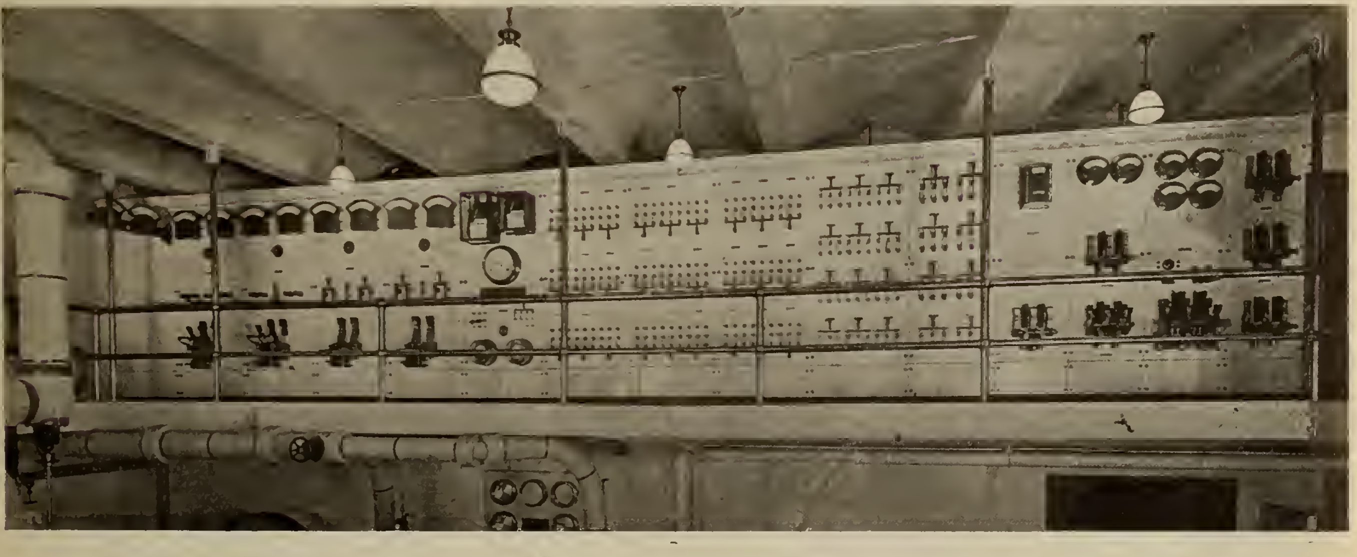
There are five a.c. service panels. One panel has a three-pole, single throw disconnecting knife switch at the back of the board for controlling the a.c. service. It has also a "Thompson" polyphase meter, and one "I.T.E." circuit breaker. The next a.c. service panel is for the motor generator. It has two "Weston" polyphase watt-meters of 30 k.w. and 100 k.w. respectively, and two "I.T.E." circuit breakers. Another a.c. panel is the frequency changer panel. This has a "Weston" a.c. ammeter, and ammeter receptacles for reading currents in any phase; one "Weston" ammeter for a.c. field; one "Weston" frequency meter, and a "Weston" volt meter. This panel has also a double pole single throw switch with discharge clips and resistance; a rheostat mounting, an eight-point potential receptacle with 4-point plug, and one 3-way ammeter switch on "I.T.E." circuit breaker.

Another a.c. distribution panel has three "I.T.E." circuit breakers. The circuit breakers are used instead of switches for a.c. distribution from the switchboard. All switches are provided with enclosed cartridge fuses, and all current carrying parts are of polished copper.

Heating System

The heating system is an interesting feature of the plant, the principle adopted being hot water heating with forced circulation. The water is first warmed in large heaters and then made to circulate through the radiators by means of centrifugal pumps, afterwards being returned through the heaters with a small loss of temperature. The heaters and pumps are located in the pump room where are also the various return mains all under direct control of the operators. Exhaust steam from the engines and pumps is used in the heater, and afterward returned to the boilers through oil filters.

The exhaust steam heater is 14 ft. 8 in. long overall and 64 in. diameter inside. It is composed of a steel shell, cast iron inlet and outlet chambers, and removable tube cover chamber fitted with a 10 in. nozzle for water connection. The heater contains 1,080 one-

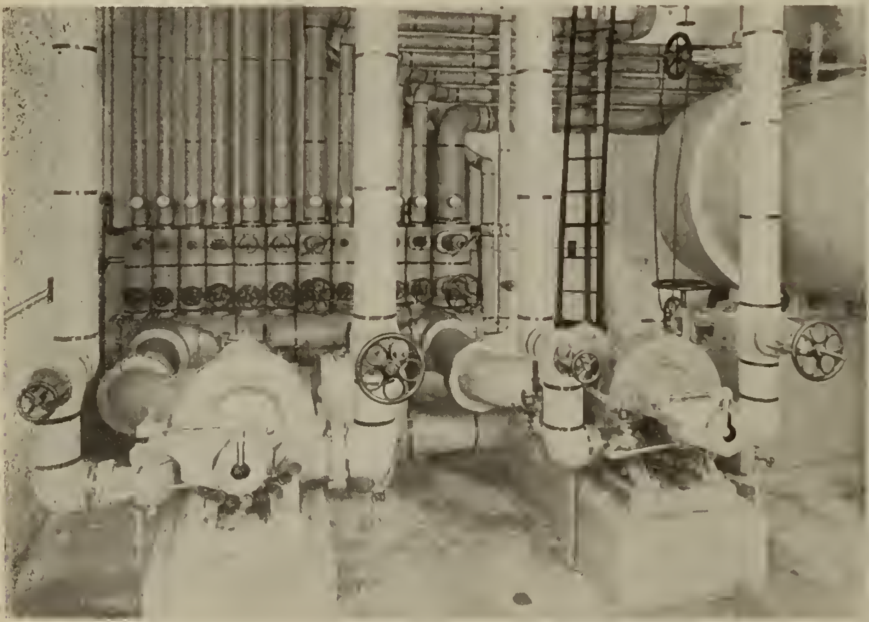


17-PANEL MAIN SWITCHBOARD DESIGNED BY THE CANADIAN DOMESTIC ENGINEERING CO., AND INSTALLED BY KEITH'S, LTD., TORONTO.

inch brass tubes and has a 2-in. diam. connection. There is in addition a live steam heater which can be used to automatically supplement the exhaust steam as needed. The live steam heater is of a similar construction as the other, but is rather smaller, being 14 ft. 8 in. long over all and 49 in. diameter. It contains 640 one-inch brass tubes and is tested to 200 pounds per sq. inch. The steam passes through, and in passing condenses, transmitting its heat to the water being pumped through the heating system. The heaters were supplied by the General Fire Extinguisher Co.

In this system the temperature of water circulated can be maintained either above or below boiling point, it also can be regulated or controlled at the heaters, thus making it possible to vary the temperature of water to suit climatic conditions. Water can be transmitted any required distance with uniform velocity and small temperature loss. The combined capacity of the heaters is sufficient to carry over 250,000 feet of radiation.

There are two pumps both of the same type for circulating the water through the building. Each pump is of the single stage centrifugal type; having a capacity of 2,100 gallons per minute against a head of 80 feet. The pumps have 10 in. inlet and outlet connections and run at 1,850 r.p.m. They have horizontally split casings giving easy access to all moving parts. Each pump is direct connected by means of a flexible coupling to a single stage, impulse steam turbine, mounted on same sub-base on concrete foundations. The pumps are provided with a 1 in. by-pass valve for operating at slow speeds, and are connected to the heating system separately, so that either unit can be operated independently as desired. The pumps and turbines are of the "De Laval" type and were supplied by the Turbine Equipment Co., Toronto. The heating system was installed by the General Fire Extinguisher Co., Toronto.

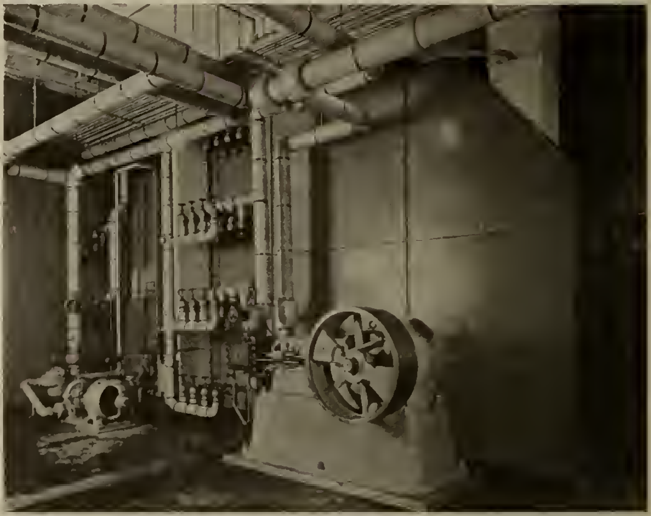


FORCED HOT WATER HEATING EQUIPMENT.

Ventilating System

The ventilating system is of the plenum type, the building being divided into two sections, each having its own fan and air washer, etc. Approximately 180,000 cubic feet of air is supplied per minute, warmed to 70 degrees Fah., washed, purified, humidified and passed through over five miles of galvanized iron ducts. The two large fans installed in the sub-basement are of the "Keith" type, and were supplied by Sheldons, Ltd., Galt, Ont. Each fan is of double width and full housed, with 70 in. diameter wheel. There are two inlets each 72 in. diameter and the outlet is 60 in. by 90 in. The capacity is 90,000 cubic ft. of air per minute when running at 180 r.p.m. Each fan is driven by a 12-in. x 12-in. horizontal central crank engine built by Sheldons, Ltd,. Galt.

The air washing and humidifying apparatus was supplied by the Carrier Air Distributing Co. of America, New York. The primary heaters of the "vento" type are arranged in two groups, each three sections high and 34 wide, each section containing 13.5 sq. ft. of radiating surface. The tempering coil is made up of two and three heating coils of four banks deep, therefore the primary heater consists of tempering and reheating coils and is made up of six banks containing a total of 16,524 sq. ft. There are also six supplementary heaters each arranged in two banks of nine 60-in. sections or 8-in. centres. The total surface per heater is 198 sq. ft. or 1,188 sq. ft. in the six supplementary heaters.



FAN ROOM, SHOWING VENTILATING EQUIPMENT.

Each of the above installations is provided with a damper which automatically controls the air flowing to the primary heaters. The damper is controlled by means of a "Johnson" thermostat. The coils are heated by means of hot water from the heating system, each section having an independent connection with the hot water heater; thermometers are provided for indicating the temperature of the water in the heaters.

The air washer has 450 nozzles placed 4 ft. from the eliminators which deflect the air five times and remove superfluous moisture. A tank under the air washer contains the water supply for the air washer. An automatic float valve keeps the water in the tank at a certain level and takes care of the loss of water which is absorbed by the air. The water is pumped from the tank and up to the air washer. A humidifier is connected to the water supply pipe and is arranged so that live steam at reduced pressure can be injected into the water going to the nozzles. A diaphragm on the water supply pipe controls the steam supply, the diaphragm being controlled by a thermostat in the air chamber. A Buffalo centrifugal pump driven by a 15 h.p. C. G. E. motor running at 1,250 r.p.m. circulates the water for the air washer.

There are also installed two "Keith"

fans for exhausting the air from the toilets. One fan is located in a shaft alongside the stairway in the north side of the building and the other fan in a similar position on the south side. These fans were also supplied by Sheldons, Ltd., and are single width full housed type. Each fan has a capacity of 4,500 cubic feet per minute at 500 r.p.m., and is direct connected to a 2½ h.p. C.G.E. motor. Each motor is supplied with starting and stopping rheostats, cut-out switches, fuses and metal containing boxes. Two "Keith" type fans of Sheldons make, are installed for exhausting from the chemical laboratories. One of these is located in a pent house on the roof in a central position, while the second fan is located on top floor on the west side. Each of these fans has a capacity of 7,000 cubic feet per minute when running at 450 r.p.m., and is direct connected to a 5 h.p. C.G.E. motor. Each motor is equipped with a speed regulating controller and a cut-out starting in a metal containing box.

The draft for the forge shop is supplied by a fan in the fan rooms. This fan is full housed, and has a capacity of 2,000 cubic feet of air per minute at 400 r.p.m. This fan was supplied by the Canadian Sirocco Co., Windsor, Ont., and is driven by a 15 h.p. Canadian Westinghouse motor 230 volts d.c. The motor is controlled by a Cutler hammer rheostat. The entire heating and ventilating equipment was installed by the General Fire Extinguisher Co., Toronto. At the entrance of the large air intake in the sub-basement is a rolling door for shutting off the supply of air when the system is not in use. The door is operated by a chain connected to a worm gear drive, the worm gear being driven by a 4 h.p. motor supplied by the Northwestern Mfg. Co., Milwaukee, Wis. The drive gear is located in the air intake near the rolling door.

PLUNGE BATH AND SWIMMING POOL.

Wiring and Lighting System

The lighting is d.c., 3-wire, 115-230 volt system, and the current is distributed through the building from six vertical ducts which have an inspection chamber on each floor. All wires are run in galvanized conduits approved by the Canadian Board of Underwriters. Four distributing panels are installed on each floor for the corridor and stairway lighting. The panels are made of black slate, and are equipped with the necessary switches, fuses, etc.

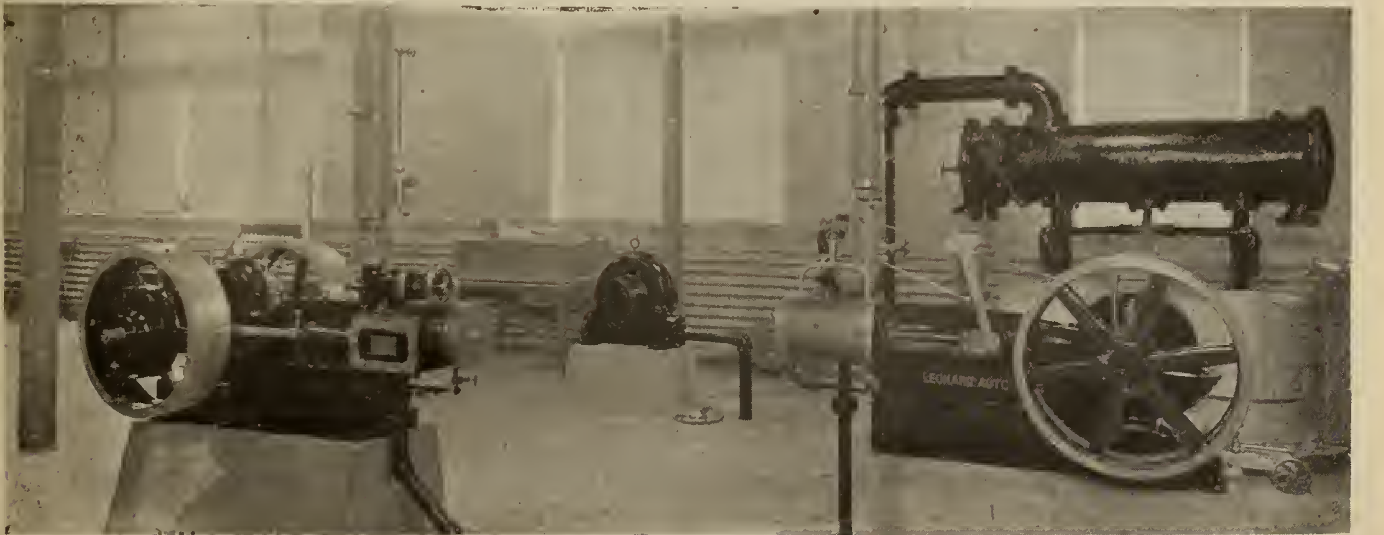
The lighting for the various rooms is distributed from the vertical ducts by means of steel encased panels on each floor. Each room is provided with a push switch, controlling the lighting there. The power for various departments is distributed in the same manner as the lighting current from power panels in the vertical ducts.

The feeders from the main switchboard are run in exposed conduit to the vertical ducts, the power and lighting feeders following the same course. Power feeders run to the machine and wood-working shops, there being a distributing switchboard in each.

The lamps in the various shops are 100 watt tungsten, with white enamelled shades. An exception to this is the machine shop, which has a number of indirect fixtures with single watt tungsten lamps. The power plant and laboratories are equipped with a direct light-system. The fixtures have special ribbed glass bowls each enclosing a 100-watt lamp. The corridor fixtures have translucent bowls each enclosing a 100-watt lamp, while red lights are installed at all the exits. The wiring was installed by Keiths, Ltd., Toronto. The fixtures in the power plant were supplied by the Tallman Brass Co., and the lamps by the Canadian Westinghouse Co., Hamilton, Ont.

Clocks, Telephones, Fire Alarm and Vacuum Cleaning Systems

The clock system was supplied by Howard & Co., Boston, Mass. There are 60 clocks installed throughout the building, all controlled from a master clock located in the assistant principal's office. The master clock has a 12-in. dial, and the movement is so constructed that it will completely wind itself from a 2-volt battery in 10 seconds or less. The secondary clocks in the boiler room, engine room, all the shops and laboratories



STEAM AND GAS ENGINE LABORATORY EQUIPPED WITH ENGINES, TURBINES, SURFACE CONDENSER, AND COMPLETE APPARATUS FOR TESTING POWER PLANT EQUIPMENT.

have 12-in. dials, and are enclosed in air-tight metal cases. All the other secondary clocks have 12-in. dials, and are enclosed in oak cases. A handsome 10-in. dial marble clock is installed in the front of the gallery in the auditorium. Current for the clock system is supplied from two storage batteries which are charged from the power circuit. The clock system was installed by Keith's, Ltd., Toronto.

An intercommunicating telephone system is installed throughout the building. There are at present over seventy stations, but these are being gradually increased as required. Nearly every room will have a telephone when the system is completed. The switchboard is located in the assistant principal's room, and a few lines are connected with the Bell Telephone Co. system. Current is obtained from a storage battery. The system was installed by Keith's, Ltd., Toronto.

A very complete fire alarm and fire-fighting system is installed. Standpipes are installed throughout the building with a fire hose service at various points in each corridor. The standpipes are connected to the city water supply system. At various points in each corridor are glass break-boxes and bells, the latter of the vibrating type with 12-in. gongs. The bells are connected in multiple and are actuated simultaneously from any one of the fire alarm boxes. Annunciators are located in the assistant principal's room, and also in the engineer's office in the sub-basement. The battery for the system is located in the sub-basement, as is also a charging panel. The fire protection system was installed by the General Fire Extinguisher Co., Toronto, and the fire alarm system by Keith's, Ltd., Toronto.

A vacuum cleaning system is installed throughout the building. The installation is divided into two parts each being handled by a four-sweeper 6½ h.p. "Tuec" machine installed in the fan room, thus making an 8-sweeper plant in all. There are 220 valves in the building to which 50-ft. hose lengths can be attached, and the system is of such size that eight men can clean the building simultaneously without overloading the machines. The machines were supplied by the United Electric Co., Toronto.

Temperature Regulation Systems

The heating system is controlled by the "Johnson" system of temperature regulation. The temperature of each room is regulated by a thermostat which controls by means of compressed air a valve on the outlet of each radiator. The compressed air is furnished by a compressor in the engine room, and will be described later.

The ventilation is also controlled by the "Johnson" system. Roof dampers equipped with diaphragms are controlled from air operated valves located in the fan room. The roof dampers are located in the exhaust air ducts. The switches for operating these dampers are all arranged on a switch-board in the fan room, thus each damper is under the control of the engineers. The compressed air for the system is furnished by a duplex steam-driven pump located near the switch-board. There is also a motor-driven air pump used as an auxiliary. Air is pumped into tank at 30 lbs. pressure; this supplies a low-pressure tank and the system with air at 15 lbs. pressure. An automatic control is fitted and so arranged that if the steam pump fails the electric pump will take its place. The entire heat regulating system was supplied and installed by the Johnson Temperature Regulating Co., Toronto.

Swimming Tank

A well-equipped part of the plant is the swimming tank, and in connection with it, showers and dressing rooms. The plunge is 50 feet long by 25 feet wide, 6 feet deep in the centre and 5 feet and 4 feet respectively at the ends. It is lined with white glazed tile and is provided with continuous filtration. The filtration and heating plant is located in the pump room, the former having a capacity of 4,000 gallons per hour. The filter is of the pressure type and was supplied by the New York Continental Jewell Filtration Co., New York. The centrifugal pump was supplied by the Smart-Turner Co., and is driven by a 2 h.p. Canadian Westinghouse variable speed motor. Adjoining the filter is a water heater under thermostatic control. The latter is of the floating head type and is heated by live steam which passes through a reducing valve, or it can be by-passed.

The pump draws water from the lowest point in the swimming tank and delivers it to the heater. It is then filtered and returned to the tank. The system is so arranged that city water can be connected to the return pipe and then through the filter. The system is also arranged so that the engineer in engine room can tell the level of water in the tank. A "Johnson" thermostat control is installed in connection with this plant.

Steam and Gas Engine Laboratory

The equipment in this section is essentially for demonstrating the operating features of prime movers for the students. The equipment consists of two steam engines, a steam turbine and a condenser, while there is also apparatus for testing and research work. In course of time other equipment will be installed such as gas and gasoline engines, etc. There is ample space provided for further equipment.

Among the units installed is a horizontal high-speed centre-crank, 7-in. x 8-in. engine built by Leonard & Sons, London, Ont. This engine has a simple slide-valve, and the valve gear is so arranged that the valve may be adjusted to any desired travel, and any angular advance may be instantly applied to the eccentric. The engine is equipped with indicator connections to the cylinders and also to the steam pipe and steam chest. Experiments can be conducted with leaky pistons or valves and any other common derangement of a steam engine. The engine is equipped with a "Gardner" governor having a wide range of adjustment. Another unit is a "Leonard" engine of the same type and size as the one described above. This engine is equipped with an inertia shaft governor and ball valve. The governor is of course attached to the flywheel, which is bolted to a disc keyed to the crank-shaft in such a way that any governor position, also any weight of governor and spring tension, can be conveniently obtained.

There is also installed a 30 h.p. "Waite" steam turbine for experimental purposes supplied by Goldie & McCulloch, Galt, Ont. This turbine has a special Goldie & McCulloch dynamometer which has an exceptional range of application and special provision for water cooling. The experimental idea is fully carried out in this machine as well as in the other units as regards facilities for examining and adjusting all working parts.

Steam is supplied from the main boilers, the supply being so controlled with valves that any desired steam pressure can be obtained for any of the units. The exhaust steam is piped to a trench in the floor and may be discharged direct to the atmosphere or to a condenser. The condenser was made by the John Inglis Co., Toronto, and has 150 sq. ft. of cooling surface. It is provided with air pump connections. In connection with the condenser are two 60-gallon capacity measuring tanks, and two 1,200-pounds capacity portable "Fairbanks" scales. The tanks and scales are for measuring condensate to obtain amount of steam used.

The laboratory is equipped with pyrometers, calorimeters indicators, dynamometers, etc., and apparatus is being installed for testing lubricating oils, fuel, gases, etc. There will also be a collection of engine models, power plant apparatus and manufacturers' catalogues, the latter being for reference. The laboratory is also used as a lecture room and is furnished for this purpose. The piping was installed by the General Fire Extinguisher Co., Toronto.

Passenger Elevator

The passenger elevator is on the west side of the building, and serves from the basement to the top floor at a speed of 250 ft. per minute, and with a capacity of 3,000 lbs. It runs in a fire-proof shaft, the machinery being located in the pent-house situated directly over the hatchway.

A car switch is provided with centreing device so that should the operator take his hand off the handle, the switch will immediately return to centre position and stop the car. The car is also equipped with wedge operated safety grips underneath the car platform.

Freight Elevator

The freight elevator serves from basement to top floor with a speed of 75 ft. per minute, and has a capacity of 4,000 lbs. The winding machine is of the direct connected type, and is placed in the pent house.

The gearing is constructed with steel worm and bronze worm wheel enclosed in heavy gear case, and running in oil to secure thorough lubrication. Other equipment consists of electric brake, automatic limit stops and automatic slack cable device. The motor is of 15 h.p. capacity, 230 volts, d.c., 4-pole, with commutating interpoles.

The operation is that of ordinary freight elevators, a hand cable passing up and down the side of hatchway. Steel guides are used for both car and counter-weight. The car is of hardwood construction, enclosed with neat hardwood sheeting on three sides with heavy wire screen on top.

Ash Hoist

The ash hoist is of the hydraulic plunger type, serving from boiler room to sidewalk. It has a capacity of 1,500 lbs., and a speed of 60 ft. per minute. The water pressure is 60 lbs. per square inch. This is used to lift ashes from the boiler room, and is provided with an iron door at the top which is opened and closed automatically by the car.

The lay-out of the power plant was prepared by the Canadian Domestic Engineering Co., Toronto, who also supervised the installation of the various units in both the power plant and gas and steam engine laboratory. The switchboard, while being designed by the Canadian Domestic Engineering Co., was supplied by the Northern Electric Co., and installed as has already been stated, by Keith's, Ltd.

REFRIGERATION DEVELOPMENT

By J. F. Nickerson

To recount the various developments that have taken place during the present generation in the refrigeration industry would be an endless task, yet it is well to call to mind some of the more important ones, and these will be sufficient to repudiate the statement which has been made that the refrigerating engineer has not made the progress that can be shown in some other lines of engineering.

In machine design the layman may perhaps not notice the changes which have taken place, but the scientific consideration of the problems of compressors has enabled all manufacturers to make these machines more efficient without much change in appearance. There has, however, been one change in compressors which is apparent to the eye and that is where formerly the water jacket enclosed the entire cylinder, it is now confined to the end where the heat is generated. This is logical for the water is warmer than the gas returning from the evaporator and if brought into contact with that part of the compressor which is cooled by the incoming gas it will have a tendency to impart heat to the gas, thus expanding it, which is just what it is desired to avoid. On the other hand, if the water can be brought into more intimate contact with that portion of the compressor which is heated in the process of compression it will be able to accomplish more good. Therefore, one now finds the heads well water jacketed while the suction ports are often insulated to prevent any heat absorption.

"Multiple Effect" Feature

It is now well recognized that the matter of filling the compressor with as much weight of ammonia as possible is most important. Compressors are in service using what is termed a "multiple effect" whereby they are filled with the returning ammonia at a higher pressure than exists in the main evaporator. This is accomplished by opening a connection to the compressor after it has filled with the gas from the main evaporator with a line from some source where the pressure is high. The result is that this higher pressure does part of the work of compressing the cylinder full of gas. This higher pressure may come from another evaporator service maintained at higher temperature, or from a special evaporator where the ammonia liquid is cooled. Then again rotary blowers have been installed on the line leading from the evaporator whereby the gas is raised in pressure with a less expenditure of energy than would be needed in the main compressor, and the main compressor is increased in capacity by being filled with gas at a higher pressure.

Absorption System

Ammonia absorption machines, operating on the principle that water absorbs ammonia gas at a low temperature and pressure and releases this gas at high temperature and pressure, have been greatly developed during the last twenty-five years and brought to a very high state of efficiency and simplicity and are now in frequent use and bid fair to become more and more a factor in plant economy, particularly for low temperature work. Especially is this true of exhaust steam absorption machines, which are making for greater plant efficiency, as they can be made to develop a large amount of valuable refrigeration from the exhaust that has heretofore been wasted. Truly no greater advance can be made in any industry than to find a use for that which is being wasted.

C. O_2 Machines

While ammonia machines have been particularly prominent in developments that have taken place, there have been as marked improvements in machinery using other than ammonia as the refrigerant. This is particularly true of the carbonic acid gas machines, the efficiency of which has been greatly increased and a large number are now in successful operation. They are claimed to be specially suitable for hotels, restaurants, on shipboard, etc. As the field of refrigeration widens the question often arises, what refrigerant is best for a given purpose. No longer does one buy refrigerating equipment simply because it can produce refrigeration, but the purchaser now asks for the type of equipment that will be the best and most efficient for the purpose for which it is to be used.

Ammonia Condensers

The ammonia condenser for many years was considered as efficient as was needed; but here too the desire for more effective results has wrought a revolution. Scientific attention has been given to their design and construction and it has been found that condensers can be made which will discharge the ammonia at a temperature within a very few degrees of the water used for cooling, and at the same time will keep the condenser pressure lower, both these results making for greater efficiency and being accomplished with less than half the amount of surface formerly required.

Among the improvements which are radical departures from the old type are the double pipe ammonia condensers, which have come into general use, but the latest development along this line is what is termed the flooded condenser, in which the hot ammonia discharged from the compressor comes in contact with liquid ammonia and is quickly condensed, resulting in a heating of the liquid ammonia. This heated liquid is then cooled by water in the usual way, but more easily, for here there is liquid on either side of the walls of the condensers, which makes possible a much more rapid transfer of heat for a given surface than would be possible where the ammonia is a gas. From a paper read before the International Engineering Congress, San Francisco.

Electricity and Hydraulics

WATER POWERS OF THE PROVINCE OF QUEBEC

THE Province of Quebec is rich in water powers. According to Government investigation the available water powers of Canada amount to 17,000,000 horse-power, of which 5,600,000 horse-power is in Quebec Province. It is stated that these figures are very conservative and could be materially increased if the flow of some of the rivers were regulated by means of suitable storage reservoirs.

The Province enjoys the advantage of excellent transportation facilities; bounded on the east by the Atlantic ocean, and traversed throughout its entire length by the St. Lawrence river, it possesses all the advantages of both a marine and inland country. The total railway mileage is more than 4,330, of which 300 miles are electrically operated. The superficial area of Quebec Province is 351,873 square miles, and in 1911 the population of the province was over 2,000,000. The thickly populated districts are those surrounding Montreal, Three Rivers and Quebec.

Among the rich natural resources of the country may be mentioned the immense forests, almost inexhaustible, the richest asbestos mines in the world and gold, copper and iron mines. The principal manufactures are shoes, textile goods, paper, railway equipment, bricks and cement.

The sources of water power of immediate importance and interest in Quebec Province are those within easy reach of the Ottawa, Montreal, Three Rivers and Quebec districts.

POWER DEVELOPMENT AT SHAWINIGAN FALLS.

Ottawa District

The principal water powers in the Ottawa district are those of the Ottawa river and a number of its tributaries. The Quinze river, really an upper portion of the Ottawa river and flowing near the Cobalt Mining district, has an available power of 90,000 horse-power, no part of which is developed at present. The Lievre river, a principal tributary of the Ottawa river, has a total available horse-power estimated at 85,000, of which less than 10,000 horse-power is developed. The Gatineau river, a still larger tributary of the Ottawa river, is capable of generating 225,000 horse-power, none of which is utilized to date. Because of its near proximity to Montreal, the Carillon rapids on the Ottawa river is of exceptional importance. This rapids is capable of developing 160,000 horse-power.

DAM AT SHAWINIGAN FALLS, QUE.

Montreal District

On account of the ready power market existing in the Montreal district, water power development has been carried out extensively. The only large water powers in the district are on the St. Lawrence river. The Cedars and Cascade rapids situated on the St. Lawrence about thirty-five miles from Montreal, and having a fall of 30 feet are capable of generating 500,000 horse-power. The present development when completed will have an output of 180,000 horse-power. To date there are nine vertical turbine units installed, each developing 10,000 horse-power, 60,000 horse-power of which is transmitted to aluminum works at Messina, and the remainder to

Montreal. The present plant of the Canadian Light, Heat & Power Company, at St. Timothee, furnishes about 20,000 horse-power to Montreal. When completed the plant will have a capacity of 50,000 k.w. About 13,000 horse-power is furnished to the Montreal consumers by a development on the Soulanges Canal, near Cedar Rapids.

The Lachine Rapids, on the St. Lawrence River, have a total available horsepower estimated at 400,000. At present only 13,000 horse-power has been developed. At Chambly, a hydro-electric plant on the Richelieu river provides Montreal with 20,000 horse-power. Montreal at the present day receives an aggregate of 126,000 horse-power supplied by falling water. Of the still available power around Montreal, 240,000 horsepower can be easily developed as the market demands. The city of Montreal, favored by its location as a seaport, and as a centre for abundant water power, offers great advantage to the manufacturer whose business involves the consumption of a large amount of power.

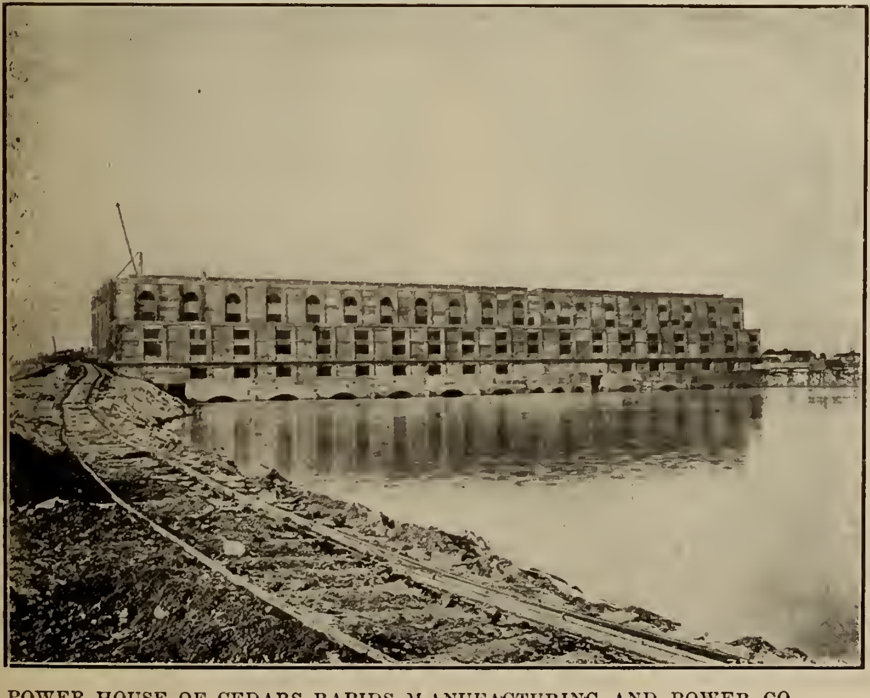
Three Rivers District

In the Three Rivers district the St. Maurice river flows for a distance of 300 miles through richly timbered areas, ending its course at the City of Three Rivers. The pending construction of a new dam on the St. Maurice river at a cost of $1,500,000, to regulate the flow of water will render this river capable of developing 650,000 horse-power. The most southerly water power on the St. Maurice is situated at Le Gres Falls, where 60,000 horse-power is available, none of which has been developed.

Shawinigan Falls, twenty-one miles from Three Rivers, is the scene of the next hydro-electric plant on the river. The entire water rights of Shawinigan Falls are owned by the Shawinigan Water & Power Company, which sells a portion of the water to local manufacturing concerns for their own use, and operates its own large power plant with the remainder. This plant is capable of generating 155,000 horse-power. Some of this power is used at Shawinigan Falls for the reduction of aluminum, the manufacture of carbide, cotton and other goods, but the larger portion is transmitted to Montreal, Three Rivers and various smaller towns, factories, and mines in the district. The flourishing town of Shawinigan Falls, with a population of 5,000, owes its existence to the development of hydro-electric power. This town is served by both the Canadian Pacific and the Canadian Northern railways, and with its abundance of water power, constitutes an ideal locality for the manufacture of products involving electro-chemical processes.

LAURENTIDE MILLS, GRAND MERE, QUE. NEW TURBINES ARE 20,000 H.P., SINGLE RUNNER.

Grand Mere Falls, on the St. Maurice, twelve miles above Shawinigan Falls, has a head of 75 feet. At present 30,000 horse-power is consumed in the manufacture of paper. The available power at Grand Mere amounts to 100,000 horse-power. At La Tuque, on the St. Maurice, about 103 miles from Three Rivers, there is a 70-foot water fall capable of developing over 75,000 horsepower. The existing pulp mills at La Tuque consumes only 3,500 horse-power There are a number of water powers north of La Tuque which still belong to the Crown, and are available for future development. Considering that Three Rivers is a port of call for both ocean and river boats, and that all the large powers are within easy reach, it is at once apparent what a unique location as regards manufacturing facilities is enjoyed by that city.


POWER HOUSE OF CEDARS RAPIDS MANUFACTURING AND POWER CO.

Quebec District

Although a vast amount of water power is available in the region directly north of Quebec City, a comparatively small quantity has been developed to date. The larger water powers in this district are practically all to be found upon rivers flowing to or from Lake St. John, and especially upon the Saguenay river, which connects Lake St. John with the St. Lawrence. At Grand Discharge, where the lake empties its waters into the Saguenay, there are two main falls, which are capable of generating 375,000 horse-power, and the water rights have been secured by the Quebec Development Company, who has in view a storage scheme whereby the above available power would be increased to over 1,000,-

000 horse-power. Construction work on this development is expected to commence in the near future. Some twenty miles below Grand Discharge is a series of rapids having an available power of over 240,000 horse-power, none of which is yet developed. At Chicoutimi, a few miles farther down the Saguenay, a hydro-electric plant is developing 7,500 horse-power, which represents about half the available power.

Among the chief tributaries of the Saguenay are the Shipshaw river with 8,000 available horse-power, some of which is being developed, and the Perabonka river with 120,000 horse-power available. A number of tributaries of Lake St. John flowing from all directions have their courses broken by numerous falls and rapids, which might be turned to great industrial use. Of those rivers running into Lake St. John, are the Ashwapmuchuan river with 250,000 horse-power available, the Mistassini and Muskosibi rivers, each with 12,000 horse-power, the Metabetchouan river with 11,000 available horse-power, and the Ouistchouan river, whose falls are capable of generating 13,000 horse-power, of which 5,000 horse-power is already developed. A vast amount of power is available in the Lake St. John region, most of which could be transmitted electrically to Quebec City, if desired, or used on the spot for electro-chemical processes and other purposes. This district is also richly timbered, and should prove attractive to those interested in the pulp and paper industrly.

Miscellaneous Power

On the north shore of the St. Lawrence River between the Saguenay and the Atlantic ocean, the country is scattered with large water powers, which, like the country itself, are entirely undeveloped. On the south shore of the St. Lawrence east of Quebec, the only power rivers are River de Loup, and Magdalen rivers, of which the available power is 3,500 and 50,000 horse-power respectively. It is estimated that nearly 1,000,000 horse power is available on the rivers scattered on the James Bay slope.

The developed water power in the Province of Quebec amounted at the beginning of 1915 to approximately 520,000 horse-power, representing less than 10 per cent. of that available. The Government of the Province of Quebec, realizing the important part its water powers are destined to play in the development of the country have inaugurated a far-reaching policy, promoting the conservation of water power.

Competent authorities foresee an optimistic future for the development of water powers in the electrification of our big railways, the increasing demand for the products of electro-chemical, and thermo-electric processes and the manufacture of artificial fertilizer from the nitrogen of the air.

* * *

ELECTRICITY FROM BELT SLIP

By N. G. Near

WITH reference to your recent publication of W. T. Estlick's scheme for removing static electricity from belts in textile mills, it is O.K. Static charges can be removed readily by "combing" it off the belts with copper or other metal strips and grounding the strips.

There is another method, though, which generally works very well, and that is to keep the belts in a "moist" condition with a penetrative belt treatment. It is a notorious fact that static troubles are at their worst in extremely dry weather. When the weather is rainy or humid the belts take up moisture from the air and static troubles disappear. The logical thing to do, then, is to create an artificial humidity by keeping the belts treated with a moistening applicating. This is highly recommended by the best belt men in the country, and wherever I have seen belts treated in this way there is no static trouble.

Another way is to create an artificial humidity throughout the whole room or building as is practised to a considerable extent now-a-days in textile mills. The air is "conditioned" mechanically by blowing air into the room continually of a certain humidity and temperature. Year in and year out there is no appreciable change in conditions in the room, there is no belt static at any time, and on account of the uniformity of these conditions there is no trouble experienced in turning out a uniform quality of goods. Of course, the air is conditioned primarily for the purpose of improving the quality of the goods and not for the sake of the belts. Benefit to belts, better sanitation and working conditions are just by-products.

* * *

OPERATION OF D.C. MOTORS AS GENERATORS

By B. H. Chatto.

THERE appears to be a lack of understanding in regard to the characteristics of a direct-current motor when operated as a generator, and the rating which may be obtained from a given motor when wound as a generator to run at the same rated speed. At first thought, it may appear that a motor having 75 per cent. efficiency could be made to deliver as a generator the same kilowatts as it will deliver horse-power as a motor, since the line amperes and voltage would be the same in either case. Such an assumption is approximately true, provided the speed is increased to a point where the machine will deliver as a generator its rated voltage at the terminals. This speed is in proportion to the motor speed as (E + IR) is to (E — IR), where E is the terminal voltage, and IR is the internal drop in the windings and brushes.

In the case just cited, a slight increase in temperature may be expected, because the armature current has been increased by an amount equal to twice the shunt field current; and because the core loss, friction and windage are greater than at the motor speed. On the other hand, heat radiated from the armature per degree rise will have increased because of the higher peripheral speed. In general, motors with a continuous duty rating operate at temperatures low enough to permit their use as generators under the conditions just outlined.

If it is desired to rewind a motor to operate as a generator at its rated speed and voltage, and to maintain temperatures equal to the motor rating, it is necessary to increase the number of armature turns in the proportion of (E+IR) to (E — IR). If the design is such that the number of turns can be so increased without any sacrifice in efficiency, an output can be obtained in watts equal to that of the motor in watts; that is, for a given temperature, generator output in watts equals the motor output in horse-power times 746. The reason for this is evident from the fact that for a given watts output and efficiency there will be the same losses whether the output is in the form of mechanical or electrical energy. In one case the losses are taken from the line, while in the other they are supplied by the driving engine motor.—Electric Journal.

* * *

DYNAMO CONSTRUCTION DATA WANTED

By G. H. Carter

I AM trying to build a 4 pole, 6 volt, 10 ampere dynamo, and have on hand 3 lbs. 6 oz. of No. 19, d.c.c. wire, also one shaft 5-16 in. in diameter by 9½ in. long, with 24 section commutator. I thought of buying 2¼ or 2½ in. diameter laminated discs with 24 slots, but cannot do so, therefore, will have to make them. The speed of machine is wanted to be about 1,800 r.p.m.

I wish to know the amount of wire necessary for the four poles, also that for the armature winding; the size of discs, size and number of slots, and total length of armature on shaft. As I intend to use only two brushes, the method of winding is also required. A sketch giving dimensions, etc., would not come amiss. Perhaps some readers of The Power House, with experience in the construction of small dynamos will find it convenient to furnish the information required.

Power Transmission Section

BALL BEARINGS

IN a paper read recently by H. J. Moysey, before the Manchester Association of Engineers, on the design and application of ball bearings, the author described the gradual development of this type of bearing from the old cup and cone pattern to that of the present day heavy duty type. He illustrated by means of lantern slides the applications of ball bearings to railway wheel axles, hot saws, ball and tube mills, Crichton openers and scutchers, cotton ring frames, sizing machines, electric motors and machine tools.

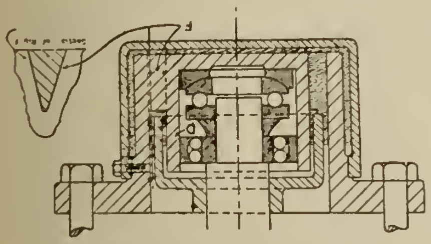


FIG. 1. FOOTSTEP BEARING FOR MORTAR MILL.

In connection with mortar mills there was described a form of footstep bearing specially designed for the purpose. The mill for which the bearing was constructed was engaged upon the pulverizing of refractory material for the manufacture of furnace linings, the dust from which was very hard, and had to be kept from the bearing surfaces. For this purpose an oil seal was provided, as shown in Fig. 1. Besides having to withstand considerable shocks due to the lumps of material being ground, the bearing had to sustain a load on the footstep of approximately 10 tons, and it had given complete satisfaction. The construction of the bearing will be readily followed from the sketch.

Another interesting application of balls was shown in connection with the central pivot of a railway turntable. As will be observed from Fig. 2, the usual ball and socket centre support has been retained, although it does not now rotate. It purpose is to allow the bearing to align itself when the table is tilted by the oncoming engine, thus preventing the whole of the load from coming on to a few balls at one side of the bearing. To minimize the expense in altering the table, it was decided that the centres of the bolts on which it hangs must not be increased, and it was therefore necessary to design a bearing that would carry the load with a sufficient factor of safety, with a diameter not exceeding 19¾ in. This made two concentric rows of balls necessary, as shown in the figure.

It was pointed out that in order to ensure that each ring of balls carried its proper share of the load, the lower half of the bearing consisted of two separate concentric steel rings, each forming one race, and these were supported on a sheet of aluminum or other material, which allowed either of the races which happened to be more heavily loaded than the other, to sink in until the load was properly distributed. A brass ring was fitted round the lower portion of the bearing housing to retain the grease.

Immediately before fitting this ball bearing, the table was tested with its old pivot, carrying an engine with a known quantity of coal and water that could be obtained again after the conversion. The total weight of engine and table was approximately 77 tons. The engine was carefully balanced and the pull required to turn it measured by a spring balance applied to the end of the table was found to be 112 lb. When the ball bearing had been fitted the same engine was run on and turned with a pull of 36 lb.

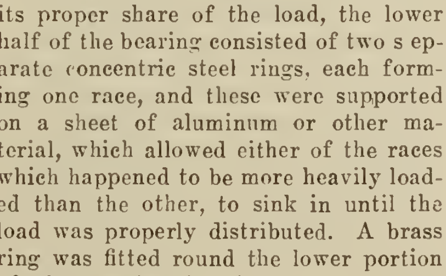
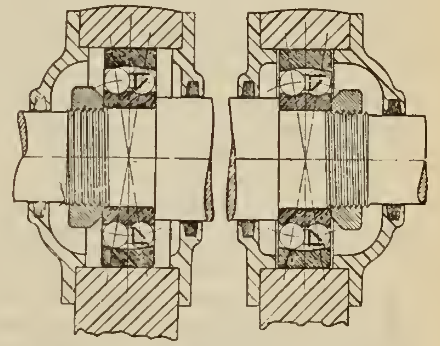


FIG. 2. CENTRAL PIVOT OF RAILWAY TURNTABLE.

With regard to the application of ball bearings to line shaftings, particulars were given of tests carried out on two shafts in different cotton mills in Bombay. In each case a length of shafting was separated from the main drive and driven by an electric motor. Both lengths of shafting were 2½ in. diameter, but were fitted with very different types of bearings, and differently loaded. The first length was 66 ft. long, carried in seven rigid brass-bushed, bottle lubricated bearings, about 1½ diameters long, and drove nine carding machines, the driving pulleys being fitted close to the bearings. The second length was about 150 ft. long, carried in 16 collar and channel bearings, 2½ diameters long, and drove a number of light machines in the preparation room, such as warp winders, bobbin winders, etc. The input to the motor, with all machines at work, was as follows:—No. 1 shaft, 9,114 watts; No. 2 shaft, 6,955 watts. The load was fairly evenly distributed along each shaft. After replacing the plain bearings by double-row ball bearings the savings were as follows:—No. 1 shaft, 1,742 watts; No. 2 shaft, 1,764 watts.



FIGS. 3 AND 4. METHOD OF MOUNTING "SKEFKO" BEARINGS ON ELECTRIC MOTOR.

Surprises was expressed that ball bearings had not been adopted to a greater extent for the shafts of electric motors, and figures were quoted to show the saving of current which could be collected by replacing the ordinary bearing by balls. Some makers, the author said, had been adversely influenced by unfortunate experiences with their first attempts, one of the most common troubles in the early days arising out of making the inner race of the bearing too slack a fit on the shaft, with the result that it crept round and gradually wore the shaft away, necessitating not only a new bearing, but a new shaft. Other makers provided too small housings, so that the outer race was a driving fit, which was unnecessary and liable to lead to trouble. The author said that unless one bearing was free to move endwise in its housing, excessive end thrust was set up when the motor heated under load and the shaft expanded; and in the second place, if the housing was not perfectly circular in the bore, as might happen through the casting having been sprung somewhat in chucking in the lathe, the outer race of the bearing would be distorted to correspond with the housing, unless it was an easy fit, and would thus put an uneven load on the balls.

Figs 3 and 4 are sectional views showing the Skefko method of mounting the bearings of an electric motor, the inner race being a tapping fit on the shaft and the outer race such that it can be pushed in by hand. It will be observed that the bearing, Fig. 4, on the right hand is fixed endwise between the housing covers, which prevents any movement of the rotor endwise; whereas the bearing, Fig. 3, on the left has freedom to slide in its housing as the shaft expands or contracts, and also to allow for any inaccuracies of machining.

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SAFEGUARDING AIR COMPRESSORS.*

THE unsatisfactory performance of air compressors, and the hazard to those who operate them, are influenced by several factors and conditions. The main contributing causes are insufficient capacity, improper installation, unfavorable operating conditions, and negligent operation and maintenance. The equipment must be adequate in size, and of proper design to deliver at normal speed the desired air volume and pressure. Any speed in excess of 500 feet of piston travel per minute should not be considered in accepting new installations. If the desired pressure at the point of delivery cannot be maintained without exceeding this speed, it is an indication of leaky valves or connections, or it shows that the compressor is too small for the requirements.

Another feature that must be considered in connection with crank-and-flywheel air compressors is the rim speed of the flywheels. Under the most favorable operating conditions, the peripheral speed of solid cast-iron flywheels should not exceed 5,000 feet per minute; and when a wheel is "built up," or composed of parts that are joined together by bolts or in other ways, the maximum allowable speed should be determined with due reference to the construction of the wheel. A light wheel with flanged joints in the rim, for example, should not be run at a peripheral speed exceeding 3,000 feet per minute. Where the duty of a compressor is subject to frequent and sudden changes, the flywheel strain is usually severe, and special allowance should be made in such a case in designing the wheel.

Air compressors should be erected and installed where the air is clean, cool, and free from dust and grit; and the power room or portion of the plant containing the compressor should be paved or floored so that it may be kept clean and free from dust. This precaution should be taken before the compressor is put in commission. It is not essential that it be located in a detached building, but when it is adjacent to a crusher building, or to a boiler room or any other department where dust is formed, the compressor room should be made dust proof.

Coupling Water Supply

When the compressors run continuously, or when the duty required of them is severe, it is vitally important to provide an adequate and unfailing supply of cooling water for the jacketed cylinder heads, and intercoolers. If the supply of cooling water is limited, or if it is of doubtful quality (containing lime or mud, for example) it will pay at the time of installation to make special arrangements to secure a better supply, or to purify the supply that is already at hand. Impure water, and consequent deposits upon the interior cooling surfaces of the water jackets, often lead to overheating and causes difficulty and trouble. All overflow water from the cooling system should be piped in such a manner that it will be plainly visible to the attendant. Direct-acting or straight-line types of compressors, with Corliss or other positive-motion suction and discharge valves, are best where the operating conditions are unfavorable, and where the skill and proficiency of the operatives are uncertain.

Air Receivers

Air tanks or receivers should be built of boiler plate of known physical qualities, and in accordance with boiler specifications. All openings for threaded pipes and connections should be reinforced, if necessary, to provide full threads. A spring pop safety valve with full size connection should be attached direct to the tank, and set to release at a pressure not exceeding the safe working pressure of the tank, using a safety factor of at least five. Air tanks should be placed so that all their external surfaces can easily be exposed for examination. They should never be put underground, nor in other inaccessible places. Manholes should be provided in all tanks that are more than 36 inches and handholes as a means of access to the interior should be provided in smaller tanks, so that the inspector can examine the interior in all cases. Every tank should also be fitted at its lowest point with a drain pipe not less than an inch in diameter, to carry off water and oil.

Stop valves in delivery lines should be omitted so far as possible. If stop valves cannot be avoided (which is sometimes the case where there is more than one compressor), they should be of gate or straight-way types. Globe valves should never be used in discharge lines. A spring pop safety valve, of sufficient area to release under an overload of 50 per cent., should be provided between the compressor and the stop valve.

Cylinder Lubrication

Compressed air is properly regarded as a fairly safe power in comparison with steam or electricity, and yet there is an explosive hazard that is not very generally appreciated, and to guard against this, particular attention must be given to the internal lubrication of the cylinders to the circulation and temperature of the cooling water. Steam cylinder oil should never be used in air cylinders. There is an intense dry heat in air cylinders, while in steam cylinders moisture is usually present to some extent. Oil will adhere to a dry surface when it would wash off of a similar surface that is moist or damp; and for this reason a smaller quantity of oil is sufficient in an air-compressor cylinder.

A pint of air-cylinder oil should be ample for a twelve-inch cylinder for twenty-four hours' running. It is sometimes difficult to adjust a gravity lubricator of this fineness of feed, and hence for this purpose forced-feed mechanical lubricators are recommended. There is danger in using too much oil in air cylinders. At a pressure of 100 pounds, the temperature in an air cylinder often reaches 400 degrees, on account of interruption in the circulation of the cooling water; and owing to the likelihood of exposure to this intense heat the cylinder oil must be of such a nature that it will not volatilize, nor form a coating of carbon or burnt oil around the discharge valves and render them inoperative. This condition is encountered in small compressors, the discharge valves of which are actuated by springs only. The carbonized matter in the cylinder oil, liberated by the application of heat and deposited in the air passages and in and around the valves, may be removed quite well by the application of soap suds or soapy water. Kerosene oil should never be used for this purpose. It becomes necessary in some cases to remove the valve bonnets once a week, to clean out the ports and passages.

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*Read before the National Safety Council at Philadelphia, by W. P. Eales, Supervising Inspector, The Travelers Insurance Co.

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PETER BAIN, M.E., Editor.

Associate Editors,
A. G. WEBSTER J. M. WILSON
J. H. RODGERS

B. G. NEWTON - - - - - Advertising Manager

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RETROSPECT AND PROSPECT

INDUSTRIAL prosperity has been a marked feature of the past year, and although unavoidably of a grim type, its immediate effect has been such as to place Canadian business and commercial enterprises on a pedestal of achievement hitherto considered beyond their grasp. The manufacture of munitions of war has demonstrated our readiness to cope with an emergency, as well as our resourcefulness, ingenuity and operative skill. Our metal-working plant capacities have been increased twofold, and, what is perhaps of greater importance, we have been enabled to break away from our traditional conservatism as regards manufacturing a greater variety product and catering to wider scope markets. Shell making on its own account and the activity developed in the machine tool and steel industries have, of course, overshadowed everything else in volume and value output.

The abnormal industrial activity arising from shell manufacture has of necessity affected more or less every other form of enterprise, some, of course, adversely, for the time being at least. Taken as a whole, however, and not losing sight of our record Western crop, it goes without saying that our lot has been far above the average during the year 1915.

Technical Education

In educational matters, and more specifically that bearing in the technical direction, there falls to be recorded the completion and opening for business of the New Central Technical School at Toronto. A very full illustrated description of the power plant feature of the Institution appears in this issue, from which there will be gathered that it occupies a place of first prominence among similar establishments the world over. Considerable impetus, as a result, has been given the movement towards technical training all through the Dominion, and particularly in the larger industrial centres. Great things are, of course, looked for from this magnificent and up-to-the-minute school, and if these materialize, we may expect to find the scope of technical education in Canada increasing by leaps and bounds with each unfolding year.

Power Plant Development

The past year, so far as the establishment of power generating plants is concerned, has been a lean one, a circumstance almost wholly traceable to the European War. Progress in the development and perfecting of new equipment has in consequence also been less marked. The demand for munitions of war from our factories has had but an indirect influence in stimulating business in power plant machinery and supplies, although the latter feature may in many lines be said to be well ahead of normal or peace times.

The urgency of the call for munitions has, however, been reflected in a very real sense upon all and every size and type of power installation. For months now, many of our industrial organizations, in order to meet the demand for shells and other war supplies, have been operating with practically no intermission, and with the latter of the briefest possible period in any case. Such a circumstance, and the fact of its having been made possible, indicates that, whatever else we may have lacked in the initial stages when transforming our workshops into arsenals, our power resources and equipment carried a generous margin. Renewals, replacements, and additions must necessarily be an early future expectation due to the strain which all power plant apparatus is undergoing.

There is little doubt that manufacturers of power plant equipment and accessories, whether of steam or hydro-electric type, have not altogether been idle in designing and developing new and improved units. They have appreciated the fact that with the new manufacturing vision and spirit dominating the activities of our plant administrators, there will be a casting about in search of the latest and most efficient power equipment with which to lower production costs and thus meet more effectually competition. The stagnation period in the realm of power equipment and specialties has lingered longer than those akin and accessory to it, yet the bottom "touching," is now quite an event of the past and every evidence is forthcoming that this new year will witness considerable activity in every sphere of power generation and application.

Peace—What Then?

Considerable speculation has been indulged in as to what the advent of peace will bring, whether business for a lengthened period thereafter will languish or whether normal if not boom times will succeed, as a result of the general endeavor to compensate for the lack of attention to our own more immediate domestic needs. It is freely hinted that our machine shops and metal working plants cannot fail then to find themselves weighted down with war-time purchased equipment, and that even with normal prosperity, the machine tool industry will go dead to stagnation.

We have traveled far these past eighteen months from a manufacturing standpoint, further than most of us have yet been able to fully appreciate. Most estimates of industrial conditions following the declaration of peace exclude this feature, and therefore, are based on those of pre-war times. As such they are of little value and but serve to indicate that those responsible for them are wholly unaware of Canada's up-to-date manufacturing achievement. The spirit behind our already-shown enterprise, although of war birth, will not evaporate or become numbed or extinct when the war ceases, but will give expression of increased vitality in directions and spheres whose scope will be immeasurably greater than even that now experienced.

Canada has struck a new stride in manufacturing, and the equipment to maintain it, she is only in process of accumulating. What will go to the scrap heap on conclusion of the war will have worthily served its immediate purpose, and its replacement will neither, we think, be irksome nor a hardship.

We were not found wanting when the munitions opportunity presented itself; we may, if we will, however, be better prepared to tackle new opportunities when the munitions manufacture ceases.

The Operators' Point of View

UNUSUAL CAUSE OF A BREAKDOWN

By A. L. Haas

BREAKDOWNS and engine wrecks have occurred from a variety of causes, but the following is probably unique. The plant consisted of a condensing steam engine with the usual auxiliary apparatus, the circulating pump having its axis vertical and being at a lower level than the horizontal steam cylinder. The circulating pump was driven by means of bell crank link from the tail rod of piston. Needless to say, the plant was scarcely modern in design. The circulating pump was of marine pattern with foot, delivery and bucket valves having ribbed radial seating. The district in which the plant operated is extremely chalky, and a water softening apparatus is used to purify the make-up boiler feed. It is possible that the bad local water made a condensing plant imperative from the boiler point of view.

Circulating Pump Valves Choked

The engine having met with a mishap involving a bad breakdown, which included a broken bell crank, cracked cylinder cover, bent piston rod, etc., was under the necessity of a considerable repair. Upon investigation, the valve seats in the circulating pump were found very nearly closed with lime deposit. Obvious neglect to periodically overhaul the pump was thus indicated. The wreck was directly attributable to this restriction of area of the pump valves, a circumstance it is believed so unusual as to constitute a precedent. In the cement industry all plant is worked to its limiting capacity and the time allowed for overhauling is cut down to a bare minimum. The pump was awkwardly situated, and the presumption is that so long as nothing happened, overhauling was repeatedly shelved until a more convenient season.

The vacuum obtained must have been satisfactory, otherwise attention would have been given the pump. The gradually choking up bucket valve seats reached the condition however, that when the usual quantity of water got between the foot valve and bucket, the water acted as a solid mass under the descent of the latter, and something of the engine mechanism had to go.

Incrustation is looked for and provided against with boiler feed water; circulating water on the other hand being simply used for cooling purposes is not generally suspected. It is probable that as the volume of cooling water diminished the temperature rose in a corresponding manner so that the deposition of the lime was cumulative in ratio to the rise in temperature. Possibly there were other contributing factors in the incrustration but not being a chemist, the writer's attention was wholly directed to the necessary repairs to get the plant under way at the earliest possible moment.

It would, however, be interesting to learn of the behavior of a centrifugal under similar conditions, but as this would be separately driven, the main engine could not suffer damage. It would appear that under the conditions related a rotary pump would be most suitable.

The reduction of area due to the incrustration exceeded 85 per cent. in some instances, while the sector between the ribs was closed entirely.

◆

THREADING DIES AND PIPE CUTTING TOOLS

By P. W. Blair.

WITH reference to the criticism by J. E. H., of my article on threading dies and pipe cutting tools, which appeared in these columns some time ago, my experience shows clearly that the majority of users of pipe threading tools do not give the latter the attention they deserve so as to maintain them in first class operating condition. If imperfect threads are produced, or they be off standard, the tool is immediately condemned, no consideration being given to the fact that a good standard thread depends on other things besides the tool employed.

Leading manufacturers of pipe-threading tools put standard marks on their dies and chasers, and make to Briggs standard. My experience is that the variation in diameters is very slight. Users of these tools do not seem to realize that they will find variations in fittings of the same manufacture and that there actually is a considerable variation in the fittings of different manufacturers.

I thoroughly agree with J. E . H. that to get good results in threading any metal, the dies or chasers must be ground to suit same with a lip or hook rake in place of a drag cut. By using the chasers with a lip cut it enables them to cut free in place of dragging or pushing the metal off.

The individual piece of pipe has something to do with the resultant thread and there is considerable variety in the quality of pipe.

You will find hard and soft spots also pipe improperly welded. You will also find pipe out of round, thick on one side and thin on the other, yet the average person using the threading dies condemns the threading tool right off hand when the threads are not perfect.

I am pleased to see that J. E. H. agrees with me when he admits that the lubricant and the proper care of tools are one of the important points for the production of good threads. The users of thread-cutting tools have found out that the question of lubrication is a serious one. I have seen tools returned for repair or for lack of thread-cutting qualities, which looked as if mucilage had been used as a lubricant.

I have also seen high-priced threading tools in some plants look as if they had never been cleaned since the day they were received.

I would like to see the user of hand and machine pipe-threading tools educated to where he at least understands the proper care of the tools and learns that good threads cannot be cut if varnish or wood filler is used as a lubricant.

Chip space is another of the practical points that must be taken into consideration when using dies, because if you have not the right amount of clearance on your chasers, the chips cannot get clear away, and pack in the teeth and strip part of the thread or tear it off. The art of tool-making has been so developed within the past fifteen years and manufacturers of pipe-threading tools have so much confidence in the quality of their product that they now furnish an unconditional guarantee.

CARBON BRUSH AND COMMUTATOR TROUBLES

By W. H. Smith

YOUR article in a recent issue on "Carbon Brush and Commutator Troubles," by E. H. Martindale, interested me very much, giving as it did insight into the remedying of commutator blackening on every other bar. One of my exciters gave similar trouble, the latter I have now stopped.

My method of testing for armature faults differs much from that of Mr. Martindale. I test for open circuits, crosses and short circuits with a galvanometer, making a bar-to-bar test along different lines from what I understand his to be. In fact I cannot see how anybody can test for an open circuit with a light if only one wire is broken. My method isn't new by any means, and, should readers of The Power House be interested, I shall be glad to submit diagram of connections with explanatory note in a subsequent issue.

◆

LICENSE LAWS FOR ENGINEERS

By C. T. R.

I READ with considerable interest and amusement in the December issue of The Power House, an attack upon shop experienced engineers by R. McLaren. Unfortunately a man is not an engineer unless he has had experience in a machine shop. How could he be?

It might be interesting for Mr. McLaren to know that Canada (particularly the Province of Ontario) is the only country in the entire British Empire where a man is recognized as an engineer without being a qualified mechanic. What is the result? Employers consider an engineer as nothing more than a laborer. Fortunately, manufacturers are now beginning to realize that it is more profitable to have skilled engineers to operate a modern power plant.

B. O. T. Certificate Requirements

Mr. McLaren's letter seems to be principally directed against British Board of Trade engineers, who of course must be mechanics. If the above class of men are as incompetent as Mr. McLaren would have us believe, it is strange how they manage to run and keep in repair the engines of the world's largest steamers. Apart from any opinion Mr. McLaren may have to the contrary, any engineer holding a first-class B. O. T. certificate is generally accepted as a man who knows his business thoroughly. In order to get such a certificate, an engineer must prove conclusively to the satisfaction of the British Board of Trade, that he has had the actual engineering experience, and then they submit him to their examiner, to find out what knowledge he really possesses. The examiner is a Board of Trade surveyor, a position which is only got through real ability, and not influence or political pull of any kind. Any engineer presenting himself for a certificate before one of these surveyors, with the hope that bluff will carry him through, generally finds to his cost that he made a big mistake.

The examination takes four full days and comprises arithmetic, a written paper, drawing to scale without copy, and finally a viva voce test before the examiner personally. A failure in the latter part of the examination is credited as lack of practical knowledge, and a candidate before making another attempt must go back to sea to gain additional experience. This means that on his next examination he must again go through the first three days in arithmetic, drawing, etc., even although he had passed these subjects satisfactorily on the first examination. The Board of Trade don't do their work in a slipshod manner.

The British Navy has been in business for many years, and all their engineers' are shop experienced. A man to be a successful engineer must be more than an engine driver. He must have been employed on the building of engines, so as to understand the construction and mechanism of the machinery in his charge, and be able to maintain same in a state of repair in order to get the highest results.

The tone of Mr. McLaren's letter will never do anything towards elevating the engineering profession in Ontario from its present mediocre position. When our license laws are placed on the same basis as the other colonies of Great Britain, engineers will be thought of in an entirely different way from what they have been in the past. It is indeed gratifying to see the advance made by the provinces in the West regarding qualifications necessary to obtain certificates, and it is certainly time that something were done in Ontario to make its license of any value.

A great deal more might be written in connection with this subject, but time and space forbids me to say more. The writer was born in Canada, but has had the opportunity of traveling around the world a few times, and observing how other countries do business.

◆

VALUE OF THE HEATER IN SMALL PLANTS

By W. F. S.

IT is a fact that many engineers of small steam plants consider it excusable, merely because of the smallness of the plant, to do without economizing devices such as feed water heaters. They think that economy is profitable only when practised on a large scale. For this reason many small plants consist of nothing but a boiler, an injector, and a simple non-condensing engine.

At least one boiler is needed in any steam plant, and in many such plants one is sufficient where a heater is provided to keep scale out. In this way the boiler needn't be cleaned and overhauled so often and continuous operation needn't be feared so much, but if you are bound to do without a heater, and if power demands are almost continuous, you had better install another boiler so that one can be cleaned thoroughly while the other is in use. Now, since a heater doesn't cost as much as a boiler, doesn't it seem logical that the heater should be given preference?

An injector, although uneconomical, is allowable as an adjunct to a pump, but if you have no pump, install one. There are many good inexpensive pumps on the market. The pump will enable you to force hot water (which has been heated in the heater by the very exhaust steam that you are now wasting) from the heater into the boiler, thereby saving from 10 to 15 per cent. of your coal.

A simple non-condensing engine in a small plant is commendable, but wherever you can make profitable use of its exhaust steam as in a heater, in heating systems, processing systems, etc., I advise that you do so. Any experienced consulting engineer will tell you the same thing. Therefore, no matter how small your plant nor how cheap your coal, you cannot honestly convince yourself or the owner of your plant that no heater is necessary. It eliminates scale, oil, and suspended particles (for heaters are usually provided with oil filters and separators); preheats and purifies the water; saves labor, coal, and boilers; receives condensates; and minimizes danger.

Even if your plant is a large one, if your engines run condensing, if the scale contains sulphates, or if you want large storage capacity for hot water, you will find that manufacturers make types and sizes that will quickly pay for themselves. There are many ways of economizing, even in plants that are now considered highly economical. We must always remember that one hundred years from now engineers will smile knowingly about our ridiculous performances in the same way that we smile about the crude methods of our fathers.

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C. P. R. Vancouver Hotel.—In the article covering this which appeared in our December issue, under the heading "Heating and Ventilating," it was omitted to be stated that Sturtevant multivane fans and air washers were installed.

Operators' Instruction Course

THE STEAM BOILER—I.

A STEAM boiler may be defined as a vessel containing water, which by internal or external application of sufficient heat to the boiler surfaces is caused to boil and evaporate as steam. This definition applies, whether the vessel be open or closed to the atmosphere.

As generally known, however, the steam boiler is a closed vessel. At the same time to serve its commercial purpose, provision at least is made whereby additional water can be added, and the generated steam drawn off or permitted to escape at will. With evaporation taking place, it becomes necessary to supplement the water supply, whether the steam or vapor be allowed to escape or not, else the boiler will boil dry, and the metallic surfaces in heat contact will burn. This provision is known as the boiler feed.

The supplementing of the original water supply or all subsequent additions give us what is known as pressure when the steam of evaporation has been prevented from escaping, or has been allowed to do so at a slower rate than that of its generation. Steam is elastic, and its continued generation under the conditions stated above necessitates each successive evaporation forcing accommodation for itself by compressing the existing vapor, thereby forming pressure. Increase of pressure causes increase of temperature and increased resistance to evaporation; the temperature at atmospheric pressure being 212° Fah., and at 500 lbs. pressure per sq. inch, 469.9° Fah.

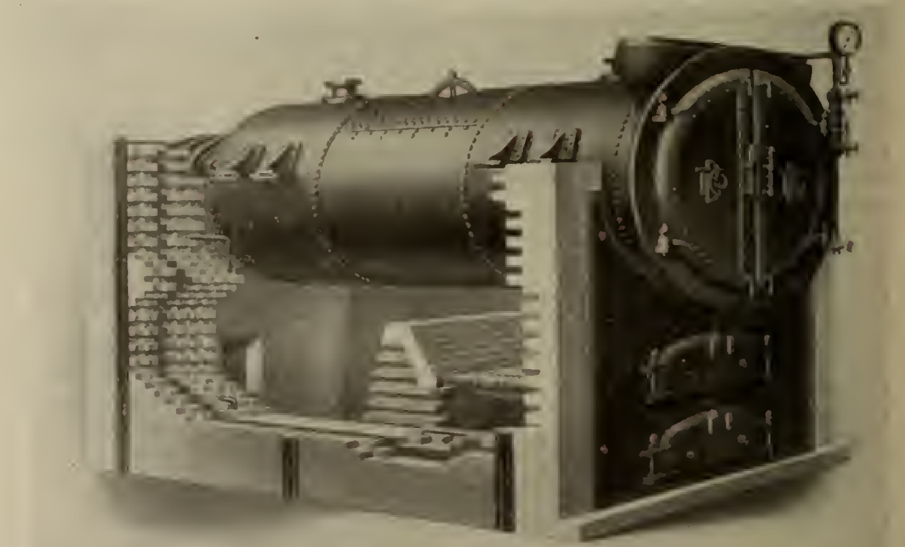
Steam Generation

To generate steam at atmospheric pressure from water at 32° Fah. requires 1146.6 units of heat per lb. of steam. The heat necessary to raise the temperature of the water from 32° Fah. or such other temperature as may be to to 212° Fah. is termed sensible heat, being observable on a thermometer and appreciable by contact. The heat necessary to evaporate the water at 212° Fah., viz., 894 units, plus that required to overcome the atmospheric pressure or surrounding steam, viz., 71.7 units, is termed latent heat, and is not observable or appreciable, the temperature remaining constant, while the liquid passes into the gaseous state. The heat units, therefore, required to generate 1 lb. of steam from water at 32° Fah. will be as follows:

Sensible heat	180.9
Latent heat, 894.0 + 71.7	965.7
Total heat	1146.6

The unit of heat is a basis of measurement, just as is the unit of weight, viz., one lb., and the unit of length, viz., one ft. The heat unit of British thermal unit (B.t.u.) is the quantity of heat required to raise the temperature of one lb. of water, 1° Fah., at or near its temperature of maximum density, viz., 39.1° Fah.

As the pressure increases, the total heat likewise increases; thus at atmospheric pressure we have 1146.6 heat units, and at 500 lbs. per sq. inch pressure we have 1225.3 heat units per lb. of steam. Further, as the pressure increases, the latent heat decreases; thus, at atmospheric pressure, we have 965.7 heat units, and at 500 lbs. per sq. inch pressure we have 779.2 heat units per lb. of steam.



HORIZONTAL RETURN-TUBULAR, EXTERNALLY FIRED BOILER, SET IN BRICKWORK.

Heat and Work

As steam, the product of the application of heat to water is used to do work, it becomes necessary to convert this heat into its work equivalent.

The unit of work is the foot-pound, and consists in the raising of one lb. through a vertical height of one foot; or, in other words, is the product of the weight and height, regardless of time occupied.

Power is the measurement of the rate of doing work, and depends on the amount of work done in a unit of time.

The unit of time is one minute. The unit of power is the horse-power, representing 33,000 foot pounds of work done in one minute.

Energy is the power of doing work. Conservation of energy is a natural fundamental principle, which applied to the steam engine shows, that heat used in the form of steam to do useful work, plus that wasted or lost, is exactly equivalent to the total heat originally generated.

The mechanical equivalent of heat, or Joule's equivalent, is the raising of the temperature of one lb. of water 1 degree Fah. by the work done on it, in the descent of 772 lbs. through a distance of one foot. Therefore one heat unit is equal to 772 units of work, and horse power expressed in heat units $= \frac{33,000}{772} = 42.75$.

Saturated steam is steam of the temperature due to its pressure, and of that of the water from which it has been generated, and with which it is in contact.

Superheated steam is steam heated to a temperature above that due to its pressure, and of the water from which it has been generated.

Transfer of Heat

When two bodies of unequal temperature are placed near to or in contact with each other, transfer of heat and equalization of temperature takes place. The rate of transfer is proportional to the primary difference, and the greater the difference, the greater the rate of flow. Heat is given off from hot bodies in rays which radiate in all directions in straight lines. The heat from the burning coal in a furnace is transferred to the crown and sides of the furnace by radiation; it passes through the furnace plates by conduction, and the water is heated by convection.

The process by which heat passes from hotter to colder parts of the body, or from a hot body to a colder body in contact with it, is called conduction. A bar of iron having one end placed in the fire soon becomes hot at the other extremity, the heat being conducted from particle to particle throughout its entire length. A piece of burning wood can be held with the hand close to the burning part. It is evident, therefore, some bodies conduct heat much more readily than others. Bodies which conduct heat rapidly are called good conductors; those which conduct heat slowly are called bad conductors.

Bad conductors are used by engineers to prevent loss of heat by radiation; hence boilers, steam pipes, and cylinders are covered with some non-conducting material, such as hair felt, or asbestos. Bodies of a finely fibrous texture are the worst conductors of heat. Liquids and gases are bad conductors.

Boilers Classification

Steam boilers may for the most part be classified into two divisions, those internally fired and those externally fired. The former have the fire-grate or furnace placed inside the boiler proper, so that the water content is in close contact with every part of the furnace containing walls. Those externally fired, on the other hand, do not have the fire-grate or furnace wholly surrounded by the contained water of the boiler.

Cornish, Lancashire, and marine boilers are pertinent examples of the internally fired type, while the return tubular boiler set in brickwork, with which perhaps the reader is most familiar on account of its almost universal service adoption on this continent, and the Babcock & Wilcox water tube boiler are excellent examples of the externally fired type.

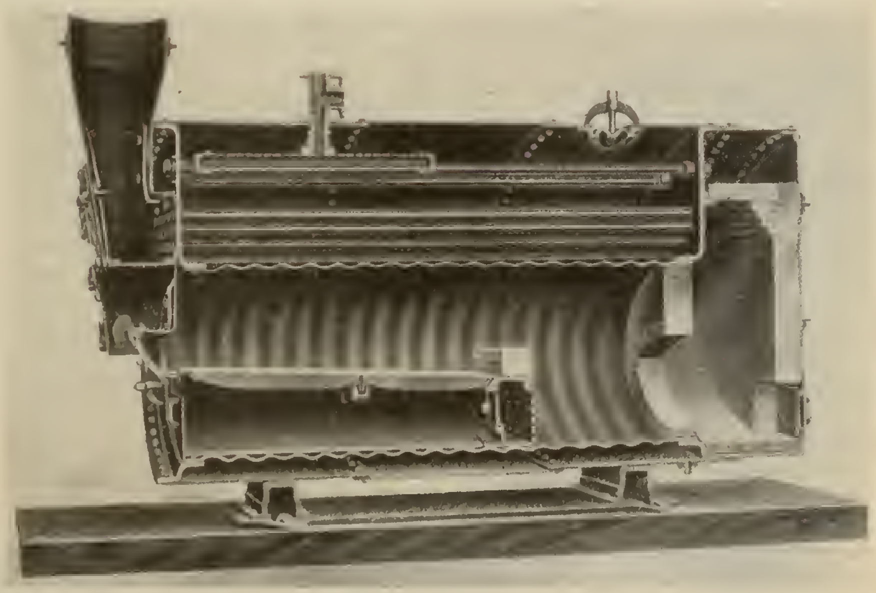
Just here it may be in order to suggest a further subdivision to distinguish between water-tube and smoke tube boilers, and this leads us to remark that while the internally fired unit is generally of the smoke tube type, it will be found that under "external firing" we have both smoke and water tube types. The return tubular boiler set in brickwork, and the B & W boiler already referred to, indicate this quite clearly.

Having briefly pointed out some distinctive features of steam generators as found in various power plants, the question naturally arises in the reader's mind as to what has to be considered when selecting a boiler. Observation and experience no doubt will enable us to conclude without much hesitation that first cost both as to manufacture and installation looms largely in the calculation. So it does, but other and equally important considerations involving design, type and service requirement come under review and these latter most often contribute to and determine the final choice.

Choosing a Boiler

On the present occasion the choice of a steam generator will only be discussed, the particular design, constructional and service features of modern boilers of the various classifications already indicated, forming the subject matter of immediately succeeding articles.

Before calling tenders for one or more new boilers, it is necessary, if ultimate satisfaction is to be had from their service operation, that an intelligent idea of our requirements be first grasped. If we simply want to replace an existing boiler or boilers, or add to those already installed we should be fully awake to the situation and be able to give good and sufficient reasons for the suggested development. Of course, it may be that it has become necessary to replace a boiler because the latter has been condemned as unsafe through age or wasting, necessitating such a reduction in working pressure as to make it altogether unsuitable for the duty we require performed. Again, it may be that our intention is to add another unit so that more opportunity may be given by systematic laying-off, cleaning and overhauling, to extend the useful life of all our boilers and at the same time keep them in a high state of efficiency, and incidentally more surely safe. Further, it may be that it has become necessary because of additions and extensions to our manufacturing plant to increase to a lesser or greater extent our boiler power.



HORIZONTAL RETURN-TUBULAR, INTERNALLY FIRED, DRY-BACK BOILER.

Expert Investigation Necessary

In all of the foregoing instances, the data on which to base our new unit requirement is right to our hand, therefore instead of simply asking that one or more boilers similar to those already doing duty be made and installed, steps should first be taken to apply expert investigation to past and existent conditions with a view to finding out their relative effect on our steam generation needs. By so doing we secure unquestionable evidence as to the degree of efficiency of our power plant at the steam generation end, have the weak spots brought prominently to our attention and are in a position to not only apply remedies and improvements to what would in any case be retained, but come into possession of data which may modify and give new direction to our views on the type and nature of the additional unit or units we purpose installing.

Question and Answer Series

Question.—Do you reckon the ammonia compression system more liable to serious trouble than the ammonia absorption system?

Answer.—Leakage of ammonia is the trouble inferred from your query, regarding which, should a break occur in the machinery equipment or its piping, there would be little to choose between the two systems. The absorption system embodies more piping than does that of compression, therefore the liability to leakage, and even breakage of pipes is correspondingly greater; on the other hand, stuffing box leakage at the ammonia end of the compressor is for the most part larger than that of the liquor pump of the absorption machine.

* * *

Question.—Can coal high in volatile matter be burned economically by forced or normal firing, and without an abnormal discharge of smoke from the stack?

Answer.—The crux of your query lies wholly in the design and arrangement of furnace. A high furnace temperature must be maintained, sufficient air must be admitted by way of the grate and a capacity of combustion chamber must be provided to ensure complete combustion of the volatile matter before the gases reach the tubes or other heating surfaces which are comparatively cooler. Carbon losses, which appear as smoke are not so extraordinary as is too often believed, seldom going beyond one per cent. These are visible and may as they sometimes do lead to prosecution because of their constituting a smoke nuisance. The escape of combustible but unconsumed gases on the other hand may reach as high as ten per cent., and at the same time give absolutely no indication of their discharge at the stack mouth.

* * *

Question.— What are the basic troubles arising from the use of impure water in steam boilers?

Answer.—Corrosion, incrustation or scale, fouling or thickening of the water in the boiler which like incrustation or scale forms a non-conducting condition; each may result from the use of impure water, and it is possible for all to be effective at one time.

Question.—Although I am aware that the purpose of a chimney in connection with a steam boiler is to produce a draft by promoting a flow of air through the furnace, I am not quite clear as to how the result is attained. A brief explanation as to the latter will be esteemed.

Answer.—The air or gases in a chimney being hot are therefore lighter than the surrounding or outside atmosphere. The latter, in consequence endeavors to force its way into the chimney from below in order to if possible restore the balance of pressure. The only inlet to the chimney is of course by way of the grate bars, fuel and furnace door grid, and, in passing through these, the air maintains combustion and becomes highly heated, making the operation of the chimney, or draft as we term it, practically continuous.

* * *

Question.—What type constituent of feed water is responsible for producing corrosion in a steam boiler?

Answer.—Corrosion, whether external or internal, is due to the presence in water in contact with boiler plates of some oxidising agent. Air, carbonic acid gas, free acids or dissolved salts such as magnesium chloride, exert a corrosive action on iron and steel.

* * *

Question.—In laying out and installing the condensing apparatus for a steam power plant what considerations must be accounted in order to contribute to its successful operation?

Answer.—The condenser should be placed as close to the engine as possible, the air pump being on a lower level than the condenser. The injection supply should not come to the pump under a head, since this would destroy the efficiency of the vacuum breaker and might allow water to be drawn into the engine cylinder. The exhaust main between the engine and condenser should be fitted with an atmospheric connection embodying an automatic exhaust relief valve. All air leaks in the exhaust main must be avoided if a high vacuum is to be maintained. The air pump should not discharge against a greater head than two feet.

Question.—For what purposes are footvalves and strainers attached to the outer end of pump suction pipes?

Answer.—A footvalve ensures the quick starting up of a pump, particularly if the lift be high—15 feet or over, or if the suction line be long—100 ft. or more, by maintaining a full volume of water in the pipe. In the case of a pump being started and stopped several times during an operative shift, the advantage of a footvalve becomes increasingly apparent. A strainer with openings of a combined area equal to four or five times the area of the pipe is attached to the outer end of the footvalve, or may form the face of a well into which the end of the suction pipe and footvalve dips. The purpose of the strainer is to prevent foreign matter, chips, etc., from finding their way through the piping to the pump.

* * *

Question.—What is the theoretical height limit to which water can be lifted by atmospheric pressure alone, and how does same compare with practice?

Answer.—The extreme theoretical height to which water can be lifted by atmospheric pressure is 33.9 feet. In practice, however, 25 feet is seldom exceeded, and in most cases effort is made to keep the lift as much below this amount as possible.

* * *

Question.—Hot water, I understand, cannot be raised by suction, why is this, and what provision must be made to deal with it otherwise?

Answer.—Hot water cannot be raised by suction because it vaporizes when the atmospheric pressure is removed, and the vapor is alternately expanded and compressed in the pump cylinders without being expelled. The pump must be located so that the water will flow to its suction opening under a sufficient head to ensure the water cylinders always being full of water, and not with a mixture of water and vapor. When the temperature of the water approaches boiling point, the head on the suction opening of the pump should be from 10 to 15 feet, and under such circumstances the size of the suction pipe should be very ample. In the case of thick liquids, those should always flow to the pump

Installation at Dill & Collins Paper Mills, Philadelphia, Pa. Photograph shows one 8-inch, two 16-inch and one 24-inch Twin Water Strainers.

Twin Strainers

Insure Continuous Service

A Twin Strainer can't be clogged up, for when one basket is dirty, a clean one is cut into service by simply moving two valves. The dirty basket can be lifted out, carried to a convenient place, cleaned and then replaced in the Strainer—all this without interrupting the service for an instant.

Twin Strainers will handle water, oil, or any other liquid, and are made in sizes ranging from 1 to 48 inches, with perforations in the straining baskets to suit your service. They can be installed anywhere —in a horizontal or a vertical line, buried in the floor, or down in a pit —wherever it is most convenient.

Twin Strainers are described in detail in Bulletin "A"
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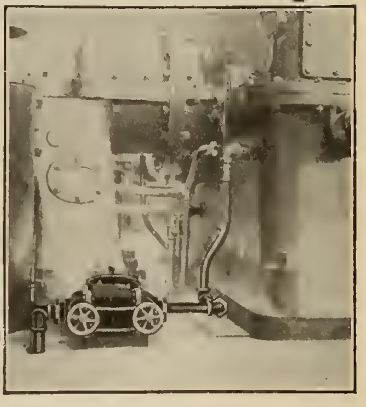
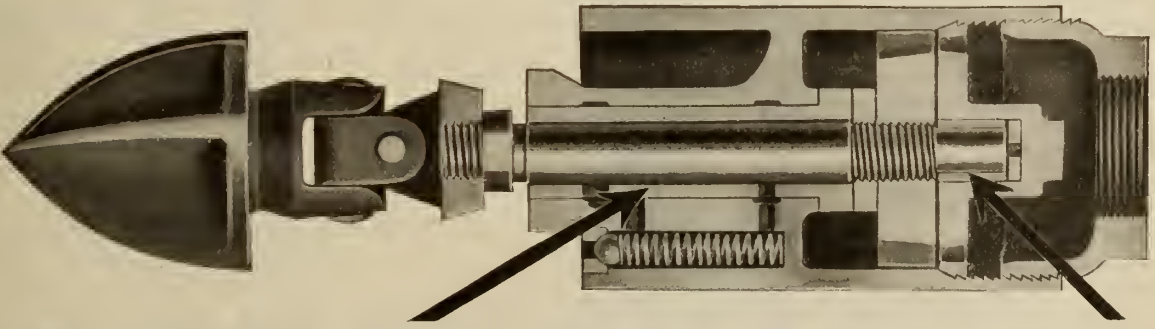


A small Twin Strainer straining the oil for the reduction gears of a large turbine.



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IN A TUBE CLEANER

Because the weight of the rotating parts is so small that the friction load on any type of bearing in good condition is negligible compared with the load of removing scale.

BUT—there is a shock load due to vibration. And you know that ball and roller bearings will not stand up under shock. And it is impossible to keep the grit and dust from the scale out of ball or roller bearings.

The LIBERTY CLEANER uses bushed bearings which do stand up under shock and which are practically impervious to grit. On account of wear, the friction load on ball or roller bearing Tube Cleaners increases rapidly with use. Friction load on LIBERTY bearings does not increase.

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LIBERTY MANUFACTURING COMPANY 6904 Susquehanna Street
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Canadian Representatives: Williams & Wilson, Ltd., Montreal; A. R. Williams Machinery Co., Toronto and Winnipeg

by gravity—in other words, under a head.

* * *

Question.—To determine the water horse-power or theoretical horse-power of a pump what data concerning the latter must be available and how must it be applied?

Answer.—To calculate the theoretical horse-power of a pump, the discharge in gallons per minute, the weight per gallon of water and the height of lift in feet including those of suction and friction heads, must be known. Multiplying all of those together and dividing by 33,000 will then give the water or theoretrical horse-power. Thhe actual horse-power depends on the efficiency of the pump, and is found by multiplying the theoretical horse-power by 100, and dividing by that efficiency. For example, if the theoretical horse-power were 30, and the pump efficiency listed at 60, then 30 multiplied by 100 and divided by 60, would give the actual horse-power required, in other words 50 horse-power.

* * *

Question.—Superheated steam is finding a large place in steam power plant operation, for which reason it must necessarily possess some considerable advantages over saturated steam. The ennumeration of a few of these will be esteemed?

Answer.—Superheated steam admits of more economical operation of the engine to which it is admitted, not wholly, however, in practice, because the steam is applied at a higher temperature and as a result enables a wider range of the latter to be compassed. Superheated steam ceases to be such, generally before cut-off takes place in the engine cylinder, in which case the theoretical economy gives place to a lesser but practical realization. As already stated, before cut-off takes place, the superheated steam admitted has become saturated, but its heat or excess temperature has gone to warm up the inner surface of the cylinder and the piston face, these having been cooled by the evaporation of water deposited on them. The economy produced reaches in some cases as high as 20 per cent., and may be stated briefly as being due to the cylinder walls and piston faces being subjected to lesser variations of temperature than is possible with saturated steam.

* * *

Question.—What is understood by the term load factor as applied to power plants or a unit of same?

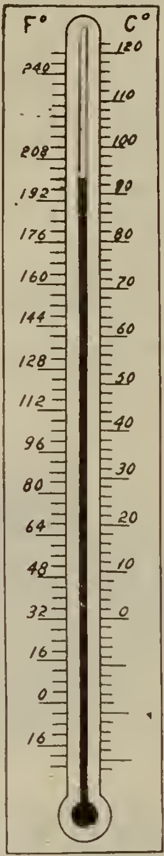
Answer.—By load factor is meant the ratio of average output to the maximum. Thus, if in an electrical installation, M= maximum kilo-watt output, and K = total output in (n) hours, then the load factor for that period is K divided by Mn. This is commonly expressed as a percentage, in which case the load factor $= \frac{K \times 100}{Mn}$. The period generally taken is one year in working days, the load factor being then =

$$\frac{\text{Total units generated} \times 100}{\text{Maximum load} \times 300 \times 24}$$

* * *

Question—(a).—What is the corresponding reading on the Centigrade thermometer of 200° Fahrenheit? (b)—What is the method used in changing a reading from one scale to the other?

Answer—(a).— 93 1-3 degrees centigrade, see skeleton diagram.



(b)—The boiling point on the Fahrenheit scale is 212 degrees, and on the Centigrade scale 100 degrees. The zero reading on the Centigrade thermometer is at the freezing point, while the freezing temperature on the Fahrenheit scale is 32 degrees above zero; therefore the space occupied by 100 degrees on the Centigrade scale is divided into 212—32 = 180 degrees, and the proportional space for each degree is

$$\frac{180}{100} = \frac{9}{5} \text{ or } \frac{100}{180} = \frac{5}{9}$$

Then by taking 9/5 of any Centigrade reading and adding 32 the result will be the same temperature on the Fahrenheit scale; or by subtracting 32 from any Fahrenheit reading and taking 5/9 of the remainder the result will be the corresponding temperature on the Centigrade scale.

By formula $F = \frac{9}{5} C + 32$ or $C = \frac{5}{9} (F-32)$; thus to change 200° F to corresponding temperature on C. scale we have

$$C = \frac{5}{9} (F-32) = \frac{5}{9} (200-32) = \frac{5}{9} \text{ of } \frac{168}{1} = \frac{280}{3} = 93\ 1\text{-}3 \text{ degrees.}$$

* * *

Question.—It is required to find the theoretical horse-power necessary to elevate a stream of water to a given height.

Answer.—Multiply the weight of water elevated per minute by the height in feet and divide the product by 33,000.

* * *

Question.—(a)—What is the steam consumption of a duplex pump with steam cylinder 12 in. diameter, water plunger 8½ inches, stroke 10 inches, when pumping 500 g.p.m., against a head of 110 feet, static and friction? Steam pressure 100 pounds.

(b)—What is the steam consumption per hour, same steam pressure and water head, pumping 500 g.p.m., when using a duplex tandem compound pump, high pressure steam cylinder 8 inches diameter, low pressure steam cylinders 12 inch diameter, water plunger 8½ inches, stroke 10 inches?

Answer.—The data given are based on average practice, as shown by tests on various makes of pumps. The dimensions given for these pumps are ordinary dimensions, and, therefore, would come under the range of ordinary practice.

As to the first question, (a) we figure the theoretical h.p. of water end.

$$\frac{500 \times 8.333 \times 110}{33{,}000} = 13.89$$

Assume the efficiency of water end approximately 80 per cent.

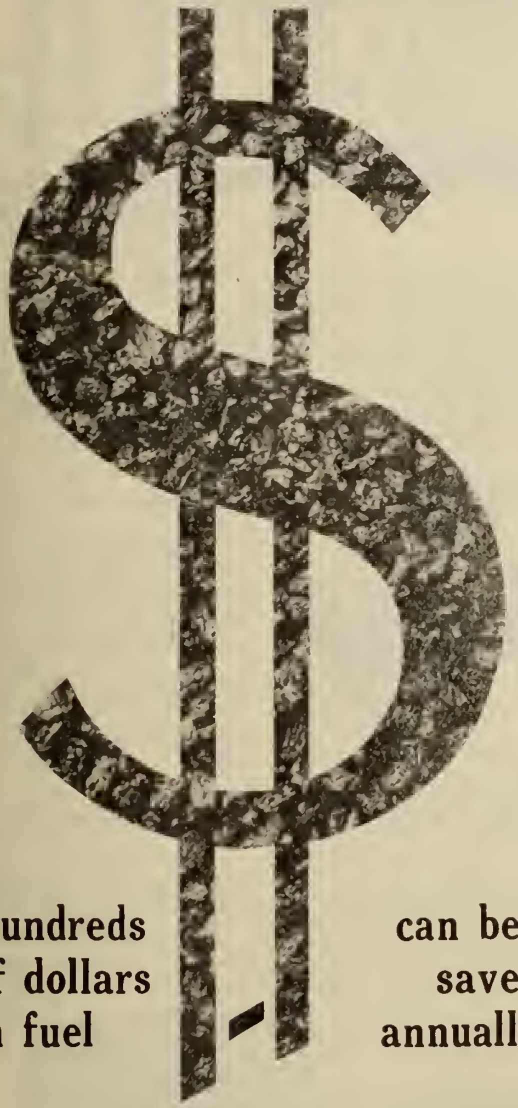
The delivered h.p. would be

$$\frac{13.89}{.80} = 17.36$$

The steam consumption at 100 single strokes per cylinder per minute may be assumed at 120 pounds per h.p., because of relatively high cylinder condensation when working under low head at rated speed. The steam consumption would be 120×17.36 = 2083 pounds per hour.

Referring to question (b), a compound pump of the size given would reduce the consumption about 20 per cent., which would make it about 1,666 pounds per hour when working at a capacity of 500 gallons per minute.

Wasted Coal Makes Wasted Dollars



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This compound acts mechanically, not chemically. It cannot injure the boiler metal or fittings. It soon removes old scale so that it can be washed out, and prevents pitting, corrosion, foaming and all boiler troubles due to impurities in the feed water.

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In Sturtevant Turbines every last detail reflects quality, correct design, and efficiency.

Look, for instance, at the exterior metal parts—and by the way, this embodies a feature unique to Sturtevant Turbines. The steam head and valve casing are of semi-steel, and when we say semi-steel, we do not use the name as a synonymous term for cast iron—we mean real semi-steel specially mixed—25% steel, 25% charcoal iron and the remainder good grey pig iron. What is more the 25% steel is not scrap. It is new stock and is thoroughly mixed in the cupola. We do not make our semi-steel by putting a small percentage of steel scraps in the pouring ladle.

Tests show that our semi-steel is 1-3 stronger than cast iron, and this additional strength is especially necessary for high pressure or superheat. Where superheat is used there is tremendous variation in the temperature of the steam, and these variations are extremely rapid. This produces excessive strains of expansion and contraction in the turbine casing.

If you have a Sturtevant Turbine, you are insured against the fatigue and deterioration which takes place in cast iron when it is subjected to superheat or high pressure.

The bearing, governor and exhaust casings are of the best grey cast iron.

For the life history of the Sturtevant Turbine you should read "How the Chief Engineer was Convinced." A copy will be sent you on request. It is bulletin 209-U.

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Progress in New Equipment

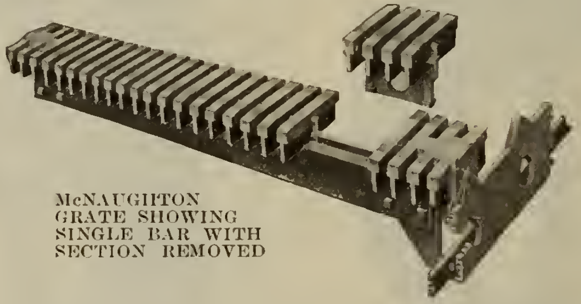
A PEN FOR ENGINEERS

THE desirability of making notes, records, etc., in ink instead of pencil is a practice which is constantly growing amongst mechanics, power engineers and others. The element of permanency is much in its favor but the necessity for ink supply, etc., occasionally is against its adoption. Many skilled tradesmen, however, include a fountain pen in their tool kit, and recent developments in self-filling pens will tend to increase the custom.

A pen which will appeal to users of this class has been placed on the market by the Laughlin Mfg. Co., Detroit, Mich. This instrument is self-filling and is conspicuous for the absence of external mechanism.

The barrel is made in two halves which when drawn apart, expose a pressure bar. A slight pressure of the finger on the bar compresses a collapsible ink tube, which when the pressure is released fills itself through the penpoint. When the barrel is closed again the appearance of the pen is that of the familiar middle-joint type.

A feature which appeals to hard users is the safety point inside the non-breakable cap. When the cap is screwed on the point section, an internal shoulder is tightened against a small flange on the end of the point section. By this means, any leakage due to rough handling or other extraordinary treatment is safely confined, and all trouble due to leakage is eliminated.


McNAUGHTON GRATE SHOWING SINGLE BAR WITH SECTION REMOVED

This pen is made in a variety of styles and sizes suited for all classes of work.

* * *

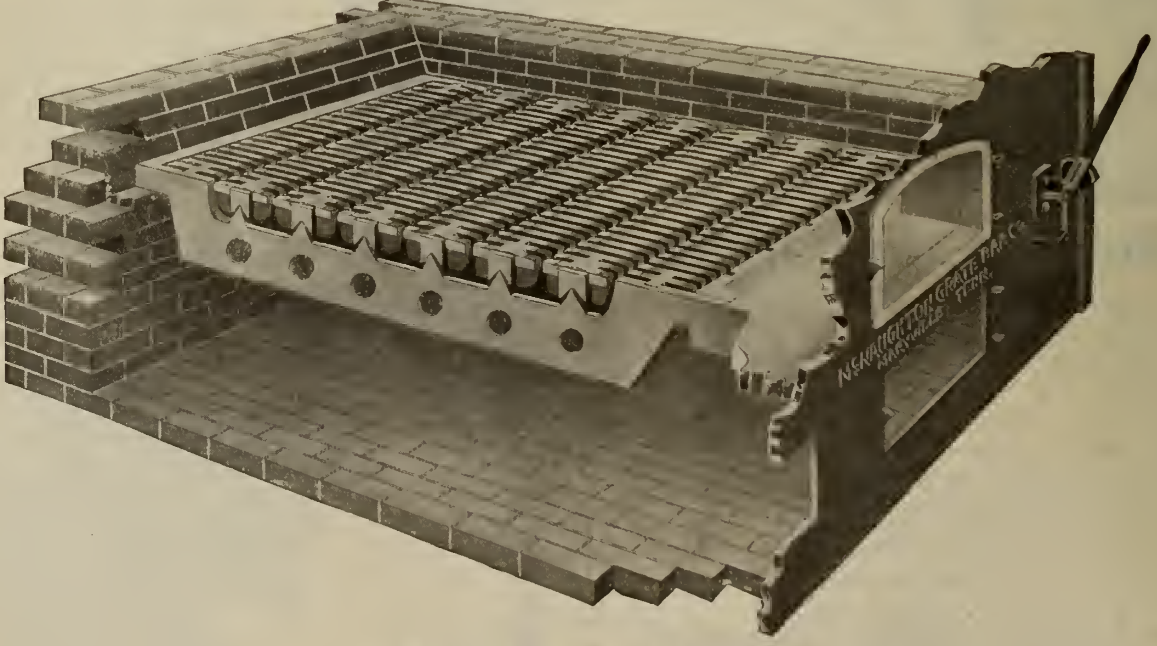
McNAUGHTON ROCKING GRATE

IN the quest for higher furnace efficiency in steam boilers, considerable development falls to be noted with respect to fire-grate types. The accompanying description, illustration and test data refer to what is known as the "McNaughton" Rocking Grate, manufactured by the Galt Foundry Co., Galt, Ont.

A prominent feature of the design is that regardless of what particular width of an opening may be demanded by any set of conditions, same is provided in desirable form—that of an uninterrupted air gap extending the whole width or length of the furnace.

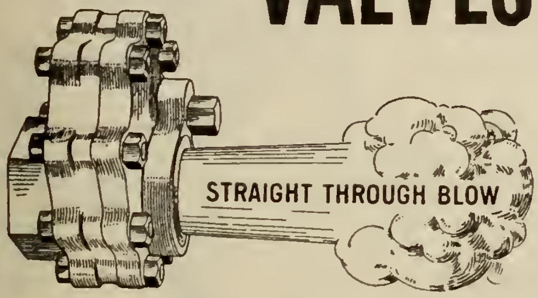
The castings on which the bars depend for strength and straightness do not come in contact with fire at any point, and any part of the bar can be easily replaced in case of injury. The ends of the bars immediately over the bearing points are thickened to give extra wear and strength and to further protect the rocking movement from the fire.

The frame castings are substantial and heavy, connections at the corners are machined fits, turned steel pins fitting into drilled holes positively securing all parts to place and insure correct alignment. The whole set of grates and framework is entirely self-contained, and will fit ordinary grate locations. The end ties are heavy blocks of iron which



ASSEMBLY VIEW OF McNAUGHTON GRATE

EVERLASTING
Blow-Off VALVES



"EVERLASTING" Blow-Off Valves will immediately end your blow-off leaks or troubles.

No Packing.

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Self-Grinding Seat.

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—NOTHING TO GET OUT OF ORDER.

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The *Everlasting Valve*—endorsed by leading Consulting Stationary and Marine Engineers.

Accepted by Boiler Inspection Insurance Companies.

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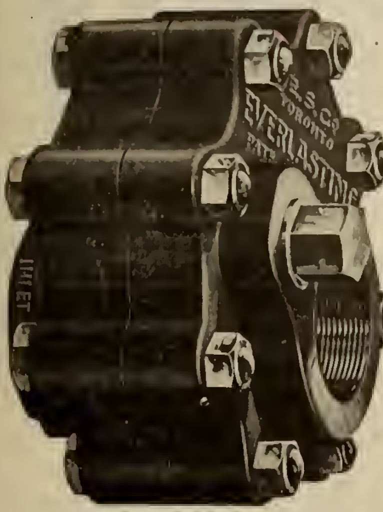
OUR GUARANTEE—Satisfaction guaranteed or money refunded within one year.

Not guaranteed against galvanic action or corrosive acid.



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Look for this ☛MARK

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DEARBORN TREATMENT

In Laundry, or Textile Mill—

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In Breweries or Ice Plants—in Mines.

In every industry where economical, efficient operation of the boiler plant is desired—Dearborn Treatment is the right thing to use to keep the boilers free from scale-forming elements—free from elements that cause pitting, corrosion or other troubles chargeable to bad boiler water.

Dearborn Treatment is made to meet actual conditions—**it is not a cure-all.**

Every barrel of Dearborn Treatment that leaves our works is made to counteract the troublesome elements which a thorough analysis of the feed water has shown to exist at the plant for which it has been prepared.

That's why every barrel of Dearborn Treatment gives satisfactory results.

Send a gallon of your boiler feed water for analysis and let us advise regarding treatment. Dearborn Treatment is applied constantly with the feed water, old scale is removed and new incrustation, corrosion, pitting, bagging and other injurious action prevented.

Boilers last longer, repair bills are eliminated, no long shut-downs required, and fuel bills are greatly reduced.

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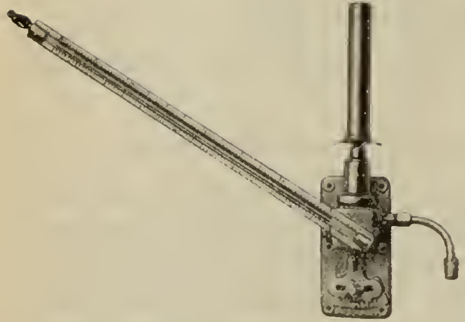

THE above cut is simply one of many types of measuring instruments, and we will be glad to supply instruments covering any class of liquid measuring on receipt of the following data:

1. S.P.G. of Liquid to be measured.
2. Depth of container.
3. Approximate location of container from Instrument.
4. Scale per foot of depth required on the instrument.
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On receiving information we will advise on best type of instrument.

This instrument measures the quantity of water or other liquid in a tank, well, stream or in almost any situation, and is absolutely free from mechanical devices, except for a small air pump at the instrument itself.

ALWAYS READY, ALWAYS SURE — ALWAYS KEEPS YOU POSTED ON THE QUANTITY OF LIQUID ON HAND, SAVES MUCH TIME AND PREVENTS "RUNNING SHORT."

Can be placed close to or far away from the liquid. It does not matter where the liquid to be measured is in relation to the device, as all you have to do is to run a piece of ¼ in. pipe from the tank to the instrument and the tank may be below or above ground, or hundreds of feet from the instrument, which latter is placed at any convenient position in the office or desired room.

Drop a line for circular and full particulars.

UNIVERSAL MEASURING
DEVICES, Limited
125 ISABELLA STREET, TORONTO

secure themselves and the rest of the grate to place by merely being dropped into position; they also thoroughly protect the edge of the deadplates.

The results of two comparative efficiency tests made on five water tube boilers (in use 16 years) at the plant of the Western Canada Flour Mills, Goderich, Ont., are as follows:

Test No. 1 was made under the old conditions with stationary grates, and test No. 2 with McNaughton rocking grates.

Palmerston, Ont.—A hydro-electric system will be installed at an approximate cost of $12,000.

The Canadian Link Belt Co., Toronto, have been awarded a contract for a coal and ash handling plant for the Dominion Government's dry docks at Quebec.

The Turbine Equipment Co., Toronto, have received an order for a 75 h.p. motor-driven De Laval two-stage centrifugal pump from the Riordan Pulp & Paper Co.

GENERAL DATA

Total Quantities	Test No. 1	Test No. 2
Date of test	March 3, 1915	May 18, 1915
Duration of test	8 hrs.	8 hours
Kind of coal used on tests	Slack	Slack
Weight of coal used as fired	24,800 lbs.	22,800 lbs.
Weight of dry coal used	23,312 lbs.	21,432 lbs.
Calorific value of coal used on tests	13.400 B.T.U.	13.400 B.T.U.
Moisture in coal used on tests	6%	6%
Total ash in coal used on tests	1,937 lbs.	1,500 lbs.
Percentage of ash in dry coal consumed	9%	7.5%
Total Combustible	21,375 lbs.	19,932 lbs.
Total water fed to boilers, actual conditions	151,372 lbs.	167,218 lbs.
Equivalent evaporation from and at 212°	184.825 lbs.	202,000 lbs.
Hourly Quantities		
Weight of coal as fired, per hour	3,100 lbs.	2,850 lbs.
Weight of dry coal used on tests, per hour	2,914 lbs.	2,679 lbs.
Weight of water evaporated per hour, actual conditions	18,291 lbs.	20,902 lbs.
Equivalent evaporation per hour, from and at 212°	23,103 lbs.	25,250 lbs.
Coal burned per. sq. ft. of grate, per hour	22.3 lbs.	22 lbs.
Boiler and Grates		
Type of boilers used on tests	Heine	Heine
Number of boilers used on tests	5	5
Heating surface of boilers used on tests	6,000 sq. ft.	6,000 sq. ft.
Horsepower of boilers used on tests	600 H.P.	600 H.P.
Horsepower developed during tests, per hour	670 H.P.	732 H.P.
Type of grate used on tests	Herringbone	McNaughton
Area of grate used on tests	138 sq. ft.	130 sq. ft.
Average Pressures and Temperatures		
Steam pressure by gauge	125 lbs.	125 lbs.
Draft at furnace in inches of water	.28 inches	.28 inches
Draft at stack in inches of water	.75 inches	.75 inches
Temperature of flue gases	540°	550°
Temperature of water fed to boilers	42°	55°
Economic Results		
Water evaporated per lb. of coal, actual conditions	6.1 lbs.	7.3 lbs.
Equivalent evaporation per lb. of coal from and at 212°	7.45 lbs.	8.86 lbs.
Equivalent evaporation per. lb. of dry coal from and at 212°	7.92 lbs.	9.42 lbs.
Equivalent evaporation per lb. of combustible from and at 212°	8.6 lbs.	10.13 lbs.
Factor of evaporation	1.221	1.208
Efficiency of boilers and grates	57%	67.9%
Cost of Evaporation		
Cost of coal f.o.b. Goderich, per ton	$2.40	$2.40
Cost to evaporate 1,000 lbs. of water	16.1c.	14.3c.
Cost to generate 100 boiler horsepower 34½ lbs.=1 H.P.	55.5c	49.3c.

The results of the test show that with the McNaughton Rocking Grate the saving in fuel was 16.1%. and that the increased efficiency of the boilers was 10.9%.

Trade Gossip

Wyoming, Ont.—The installation of an electric light system is contemplated to cost about $6,000.

Robert Archer, a prominent business man in Montreal and a director of the Northern Electric Co., died on January 7, aged 79.

Paul J. Myler, general manager of Canadian Westinghouse at Hamilton, Ont., has been elected a director of the Bank of Toronto.

David Arthur Law, superintendent of the Waterworks Department, Prince Albert, Sask., died in Winnipeg, Man., on Dec. 9, aged 46.

Ralph W. Ashcroft, of the Canadian Consolidated Rubber Co., of Montreal, has accepted the appointment of manager of publicity of the United States Rubber Co., of New York.

C. C. Johnson, B.A.Sc, has been appointed resident engineer at London, Ont., representing Chipman & Power, consulting engineers, Toronto, who are responsible for the proposed sewage disposal plant.

Wyoming, Ont.—The ratepayers on January 7 voted in favor of installing hydro-electric power by a vote of 101 to 11. The proposal voted upon was for an expenditure of $5,500 on station and plant. Work will be commenced at once.

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POWDER

BOILER CLEANSER

A BIG FACTOR IN KEEPING DOWN POWER COSTS

A little used daily in the feed water will destroy old scale in a short time and prevent any new formation, foaming, pitting, and all boiler troubles due to impurities in the water. It will reduce your fuel bills to a minimum and increase the efficiency and capacity of your boilers.

Made to suit feed water conditions and contains nothing that will cause the slightest injury to boiler metal or fittings.

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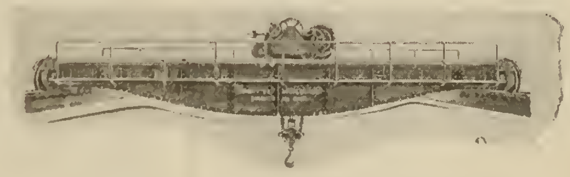

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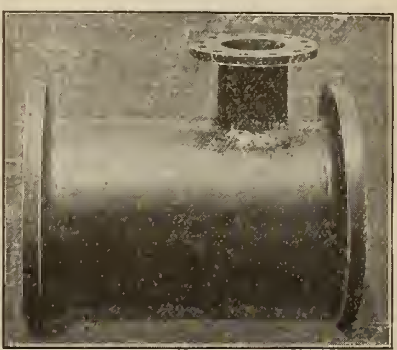
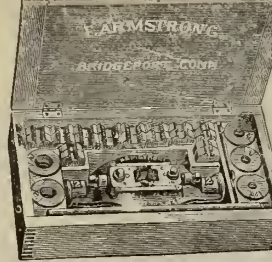


Fig. 2.—18-in. Steam-Pipe Tee with Flanges and Branch Welded on Electrically.

If what you want is not advertised in this issue consult the Buyers' Directory at the back.



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MALLEABLE IRON HINGED
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POSITION WANTED—STEADY AND RELIABLE stationary engineer with knowledge of electricity. Age 40. References supplied. Wm. Nuttall, Box 67, Preston, Ont.

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75 H.P., 16 x 36 Leonard Corliss, used less than year; heavy duty type.
85 H.P., 13 x 30 Brown automatic, excellent condition.
75 H.P., 12 x 30 Inglis Corliss
75 H.P., 12 x 12 Robb high-speed.
20 H.P. Robb high-speed.
BOILERS.
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200—300-light dynamos.
20, 25, 35, 250-volt motors.
50 H.P. gas engine and producer, good as new, at great bargain.
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INFALLIBLE
Works Equally Well on Hot and Cold Surfaces. It Cannot Blow Up. Cleans, Polishes and Preserves all kinds of metals.

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Residence: 686 South Side Parkway
Bell Phone, Abbott 565-W.

The Dominion Coal Co., Sydney, N.S., have purchased two 75 h.p. direct-current motor-driven De Laval two-stage centrifugal pumps from the Turbine Equipment Co., Toronto, Ont.

William A. Conner, vice-president of the Standard Underground Cable Co. of Canada, Ltd., Hamilton, Ont., died Dec. 6. The deceased, who was a resident of Plainfield, N.J., had been a director of the above company for the past ten years and first vice-president since 1909. He planned and constructed the Hamilton works.

The Turbine Equipment Co., Toronto, have received an order from the Brockville Water & Light Commission for one 4-million gallon De Laval steam turbine connected to a De Laval centrifugal pump through the medium of double helical reduction gears; also one 3½-million gallon and one 2-million gallon De Laval motor-driven pump. One C. H. Wheeler jet condenser will also be installed.

C. F. Morse Co. Roll of Honor.—Fifty-two of the staff of the Canadian Fairbanks-Morse Co. have joined the overseas forces. Montreal has sent 15; Toronto 7, St. John 8; Winnipeg 10; Calgary 2, and Vancouver 10. Graham Drinkwater, vice-president, states that the company will keep open the positions of those enlisting, and adds: "We believe every Canadian business man should realize that the first business of this country is to help terminate this war, and this can only be done by sending our men, giving our money, and helping the great cause in every possible way open to us."

Catalogues

The "Cole" Boiler Feeder is illustrated and described in a bulletin recently issued by the Geo. W. Cole Co., Toronto, Ont. A table is included, giving the capacity and price of each size of trap. Other apparatus described and illustrated includes the "Otis" heater, and the "Kitts" pressure reducing valve.

Friction Clutches.—The "Johnson" friction clutch as applied in machine building is illustrated and described in a catalogue issued by the Carlyle Johnson Machine Co., Manchester, Conn. The catalogue contains a number of testimonials from various well-known firms who have installed these clutches on their machines. On the opposite page to each testimonial is an illustration of the machine referred to, showing location of clutch. The catalogue also serves to show the wide application of the Johnston clutch and its principal features.

Heating Water With Steam is the title of a catalogue issued by the Alberger Heater Co., Buffalo, N.Y. The catalogue deals with the "Alberger" multi-head water heaters for various services and contains views of buildings and plants where they have been installed. The construction of this heater is described fully and reference is made to the efficient heat transmission. Tables for the 1915 U.S. standard pipe flanges, a table of flow of steam through pipes and a table of temperature differences are included. The catalogue concludes with a description of the Ross expansion joint which is also illustrated.

Steam Tables for Condenser Work.—The third edition of this handbook of steam tables has been published by the Wheel Condenser & Engineering Co., Carteret, N.J. The book contains 31 pages, 14 of which cover three tables, No. 1 being a vacuum table and giving properties of saturated steam from 29.8 in. of vacuum to atmospheric pressure. No. 2 is a temperature table and gives properties of saturated steam from 30 degrees to 212 degrees Fah. No. 3 is a gauge and absolute pressure table and gives the properties of saturated steam from 0 lbs. gauge pressure to 200 lbs. gauge pressure. The concluding section contains constants and tables, etc., for the correction of readings. The steam tables are based on the properties of saturated steam given in the latest tables of Marks & Davis and were especially calculated for this book by Prof. Marks. This useful publication may be obtained on application from the Wheeler Condenser & Engineering Co.

Establishing and Maintaining Boiler Room Economy is the title of a paper presented before the Ohio Society of Mechanical, Electrical and Steam Engineers, by Geo. H. Gibson, developing the thesis that the most important requisites to further improvements of boiler plant economy are means of recording boiler performance—that is, of determining the number of pounds of water evaporated per pound of coal. Information obtained sporadically, as by means of short boiler tests, is not so suitable for this purpose as is information supplied continuously through a feed

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water meter. The relative values of different kinds of coal, the improvement in evaporation following cleaning of soot and scale off heating surfaces, or the stopping up of air leaks, the relative merits of different methods of firing, are then readily demonstrated, and scientific management becomes easy and natural. That is, the ways and means of attaining a certain standard of performance having been demonstrated, the management is in a position to ask for good results continuously; in fact, standard rules of operation—that is, directions as to methods of handling fires, regulation of draft, blowing of soot, banking fires, carrying over-loads, etc., can be written out, so that any man following instructions can obtain good results. The installation further arouses the pride of the engineer, and makes it possible to reward skill or attention to duty. This pamphlet is being distributed by the Harrison Safety Boiler Works, Philadelphia, Pa.

Book Reviews

The "Mechanical World" Pocket Diary and Year Book for 1916. Published by Emmott & Co., Ltd., Manchester, England. Price, 25c. The twenty-ninth issue of this extremely useful little publication is now on sale, and, as is the usual custom, additional information has been introduced. The section on steam boilers has been largely rewritten and enlarged, including particulars of boiler scantlings, the requirements as to boiler mountings, etc. A separate and enlarged section is now devoted to the Diesel engine, embodying a good deal of concisely arranged data which will be appreciated by designers. Some notes on brazing and soldering have also been introduced. Among the several new tables, mention may be made of those relating to Lancashire and Cornish boilers, dimensions of locomotive boilers, steel plates, friction clutches, circle spacing table, etc. Other tables have been extended, and the book generally has been thoroughly revised. The book contains 264 pages full of useful engineering notes, rules, tables and data, etc.; while in addition there is the usual diary, index and advertising matter, a total of 429 pages. The book is fully illustrated and bound in substantial cloth covers.

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50 TO 60 H.P. ENGINE. GOLDIE-McCULloch "Wheelock" type. Cyl. 10 inches dia., stroke 28 inches, noncondensing. At 90 revs. per minute and 100 lbs. steam pressure this engine develops 60 H.P. It is in excellent condition and perfect working order and complete in every way with fly wheel. Inspection is invited. Inquire of Process Engineers, Limited, McGill Building, Montreal, P.Q., or London Soap Co., South Street, London, Ontario.

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returned to boilers at
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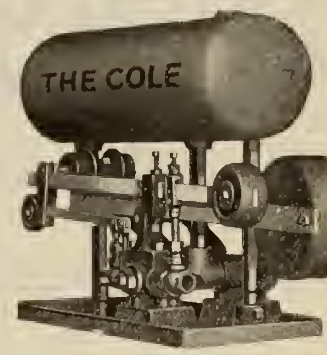

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You do not have to cool it down to 180° to accommodate your pump.

The result is an enormous saving of fuel.

The good circulation means top-notch efficiency.

Operates on roller bearings, on a fixed Fulcrum, which permits a full discharge at each operation.

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NOTICE

To Manufacturers, Dealers and Users of Steam Boilers

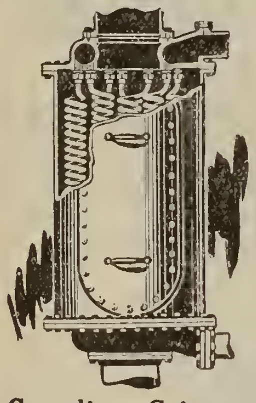
All steam boilers built in, or entering the Province of Ontario, and boilers exchanged or repaired are subject to Government Inspection as prescribed in the Steam Boilers Act, 3 George V., C. 61.

Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department, stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the Regulations by an Inspector authorized under the Act.

All communications should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. FINLEY G. MACDIARMID, Minister of Public Works.

D. M. METCALF, Chief Inspector of Steam Boilers.



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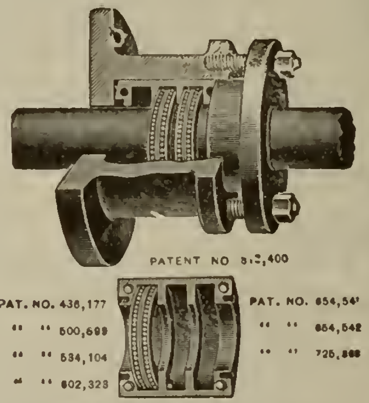

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TO

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Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

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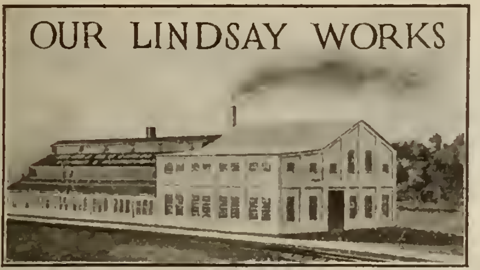

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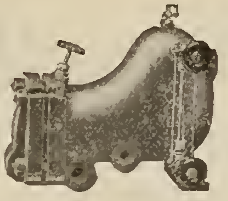

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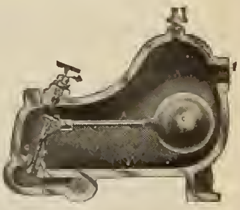

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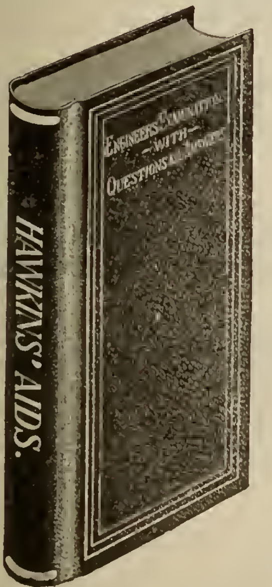

This work is an important aid to engineers of all grades, and is undoubtedly the most helpful ever issued relating to a safe and sure preparation for examination. It presents in a condensed form the most approved practice in the care and management of Steam Boilers, Engines, Pumps, Electrical and Refrigerating Machines, also a few plain rules of arithmetic with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the Steam Engine and Steam Boiler.

It contains various rules, regulations and laws of large cities for the examination of boilers and the licensing of engineers.

The book gives the underlying principles of steam engineering in plain language, with very many sample questions and answers likely to be asked by the examiner.

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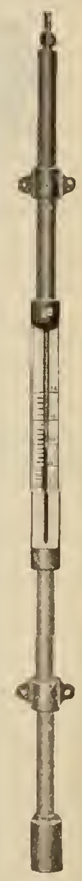

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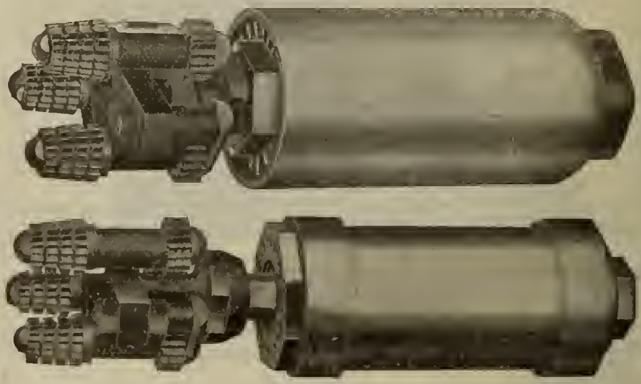

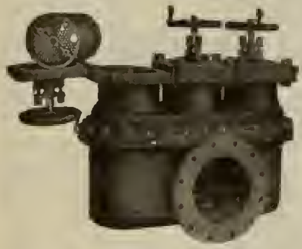

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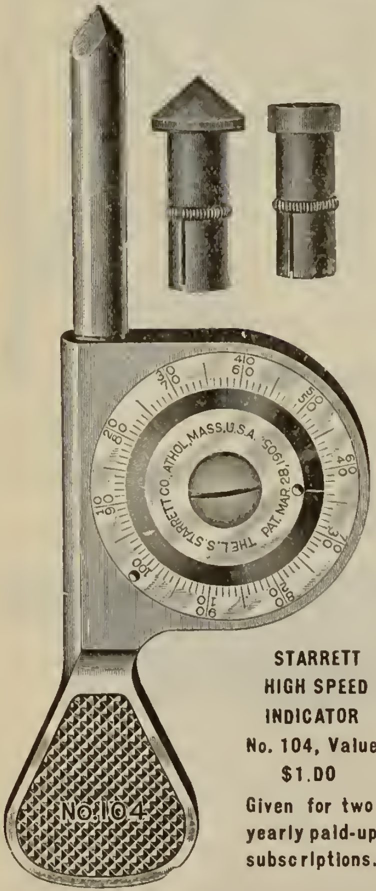

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Babcock & Wilcox, Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Geo. W. Cole Co., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Liberty Mfg. Co., Pittsburg.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.

Oiling Systems.
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.

Oils, Lubricating.
Albany Lubricating Co., New York City.
Can. Oil Companies, Ltd., Toronto.
C. C. Snowdon, Calgary.

Packing, Engine.
Can. H. W. Johns-Manville Co., Toronto.
Cassco Bar-Metallic Packing Co., Chicago Ill.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

Packing, Hydraulic.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

Packing, Metallic.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Cassco Bar-Metallic Packing Co., Chicago. Ill.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

Packing, Air Pump.
Cassco Bar-Metallic Packing Co., Chicago, Ill.

Packing, Rod.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.
Steel Mill Packing Co., Windsor, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

Packing, Sheet.
Garlock Packing Co., Hamilton, Can.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Jenkins Bros., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

Packing, Ammonia, Steam and Water.
Canadian H. W. Johns-Manville Co., Toronto.
Garlock Packing Co., Hamilton, Can.
Greene, Tweed & Co., New York.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

Packing, Leather.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

Paint, Damp Resisting.
International Varnish Co., Toronto.

Penstocks.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

Pillow Blocks.
Can. Bond Hanger & Coupling Co., Alexandria, Ont.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Waterous Engine Works Co., Brantford, Ont.

Pipe Coils.
York Mfg. Co., York, Pa.

Pipe Threading and Cutting Machines (Hand, Belt and Motor).
Borden Canadian Co., Toronto.
Oster Mfg. Co., Cleveland, O.

Pipe Steel.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Wm. Hamilton Company, Ltd., Peterborough, Ont.

Pipes, Water.
Aiton & Co., Ltd., Derby.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

Piping and Fittings.
Frick Co., Waynesboro, Franklin Co. Pa.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

Piping, Steam.
Babcock & Wilcox, Montreal.

Planimeters.
Richard Thompson & Co., Toronto.

Plate Work.
Goldie & McCulloch Co., Galt.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

Polish, Metal.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
G. W. Hoffman, Indianapolis.

Power Pumps.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
C. A. Dunham Co., Ltd., Toronto.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart - Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Canadian H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Can.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

Power Transmission Machinery.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Jeffrey Manufacturing Co., Montreal.
Jenckes Machine Co., Sherbrooke,
Jones & Glassco, Montreal.
John Millen & Son, Montreal.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

Presses.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

Pressure Blowers, Centrifugal.
Can. Sirocco Co., Windsor, Ont.

Pulleys.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Fairbanks-Morse Co., Montreal.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

Pulp Mill Machinery.
The Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

Pumping Machinery.
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.
Waterous Engine Works Co., Brantford.

Pumping Machinery, Electrical.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Hamilton, Ont.
Terry Steam Turbine Co., Hartford, Conn.

Pump Governors and Regulators.
Bawden Machine Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
G. M. Davis Regulator Co., Chicago.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

Pump Strainers.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
C. A. Dunham Co., Ltd., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

Pumps, Air.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Storey Pump & Equipment Co., Ltd., Toronto.
Terry Steam Turbine Co., Hartford, Conn.
Wheeler Condenser & Engineering Co., Carteret, N.J.

Pumps, Contractors'.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
William Hamilton Co., Ltd., Peterborough.
Smart, Turner Machine Co., Ltd., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Hand and Power.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart, Turner Machine Co., Ltd., Hamilton, Ont.
Stewart Heater Co., Buffalo, N.Y.

Pumps, Centrifugal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bromell Patents Co., Ltd., Glasgow, Scotland.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.
Turbine Equipment Co., Toronto.
Waterous Engine Works Co., Brantford.
Wheeler Condenser & Engineering Co., Carteret, N.J.

Pumps, Geared, Compound.
American Steam Pump Co., Battle Creek, Mich.
The Bawden Machine Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Hydraulic, Pressure.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart, Turner Machine Co., Ltd., Hamilton, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Terry Steam Turbine Co., Hartford, Conn.

Pump Leathers.
Graton & Knight Mfg. Co., Montreal.

Pumps, Oil.
The Bawden Machine Co., Toronto.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Steam Turbo.
Hare Engineering Co., Toronto.

Pumps, Steam.
American Steam Pump Co., Battle Creek, Mich.
The Bawden Machine Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
Goldie & McCullough Co., Galt.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

Pumps, Triplex.
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Smart, Turner Machine Co., Ltd., Hamilton, Ont.
William Hamilton Co., Ltd., Peterborough.

Pumps, Vacuum.
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C. A. Dunham Co., Toronto.
John Inglis Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.
Wheeler Condenser & Engineering Co., Carteret, N.J.

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Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
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Canadian Griscom-Russell Co., Ltd., Montreal
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Cling Surface Co., Buffalo.

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Liberty Mfg. Co., Pittsburg, Pa.
Quaker City Rubber Co., Philadelphia.

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The Bawden Machine Co., Toronto.

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Roto Co., Hartford, Conn.

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Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Wks. Co., Brantford.

Shaking and Dumping Grates.
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Can. Steam Boiler Equipment Co., Toronto.
Galt Foundry Co., Galt, Ont.
Waterous Engine Wks. Co., Brantford.

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Babcock & Wilcox, Montreal.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Wks. Co., Brantford.

Smokeless Furnaces.
Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, England.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Wks., Detroit, Mich.
Geo. H. Tod, Toronto.

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Richard Thompson & Co., New York.

Special Machinery.
The Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Fairbanks-Morse Co., Montreal.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Wks. Co., Brantford.

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Can. H. W. Johns-Manville Co., Ltd., Toronto.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

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Waterous Engine Wks. Co., Brantford.

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Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Can. Fairbanks-Morse Co., Montreal.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Waterous Engine Wks. Co., Brantford.

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Wm. Hamilton Company, Ltd., Peterborough, Ont.

Stand Pipes, Steel.
William Hamilton Co., Ltd., Peterborough.
MacKinnon, Holmes & Co., Sherbrooke, Que.

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Babcock & Wilcox, Ltd., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Penberthy Injector Co., Windsor.
Smart-Turner Machine Co., Ltd., Hamilton.
Watson & McDaniel Co., Philadelphia.

Steam Specialties.
Alberger Heater Co., Buffalo, N.Y.
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Canadian Griscom-Russell Co., Ltd., Montreal
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Geo. W. Cole Co., Toronto.
Darling Bros., Montreal.
C. A. Dunham Co., Toronto.
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Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia.

Steam Traps.
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Can. Fairbanks-Morse Co., Montreal.
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Can. Sirocco Co., Windsor, Ont.
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Darling Bros., Montreal.
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E. S. Manny Co., Montreal.
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Watson & McDaniel Co., Philadelphia.

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Steel Drums.
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William Hamilton Co., Ltd., Peterborough.

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Detroit Stoker Co., Detroit.
Hare Engineering Co., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Manning Chambers, Toronto.

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Waterous Engine Works Co., Brantford, Ont.

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Jones & Glassco, Montreal.
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Babcock & Wilcox, Ltd., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.

Tubes, Boilers.
Babcock & Wilcox, Montreal.

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Babcock & Wilcox, Ltd., Montreal.
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Tungsten Lamps.
Bawden Machine Co., Toronto.
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Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Boving Co., Hamilton.
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Jenckes Machine Co., Sherbrooke, Que.
William Hamilton Co., Ltd., Peterborough.

Turbines, Steam.
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De Laval Steam Turbine Co., Trenton, N.J.
Hare Engineering Co., Toronto.
Kerr Turbine Co., Wellsville, N.Y.
Laurie & Lamb, Montreal.
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Terry Steam Turbine Co., Hartford, Conn.
Turbine Equipment Co., Toronto.

Unions.
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Canadian Steam Boiler Equipment Co., Toronto.
G. M. Davis Regulator Co., Chicago.
C. A. Dunham Co., Ltd., Toronto.

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Darling Bros., Montreal.
C. A. Dunham Co., Ltd., Toronto.
Smart - Turner Machine Co., Ltd., Hamilton.

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Geo. W. Cole Co., Toronto.

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Graton & Knight Mfg. Co., Montreal.

Valve, Reseating Machines.
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Darling Bros., Montreal.

Valves, Air Line.
C. A. Dunham Co., Ltd., Toronto.

Valves.
Babcock & Wilcox, Ltd., Montreal.
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Homestead Valve Mfg. Co., Pittsburg.
Jenkins Bros., Montreal.
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Mason Regulator Co., Boston, Mass.
Watson & McDaniel Co., Philadelphia.

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Engineering Specialties Co., Toronto.
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Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart, Turner Machine Co., Ltd., Hamilton, Ont.

Valves, Gates.
Babcock & Wilcox, Ltd., Montreal.
Geo. W. Cole Co., Toronto.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Valves, Reducing.
C. A. Dunham Co., Ltd., Toronto.
Liberty Mfg. Co., Pittsburg, Pa.
Mason Regulator Co., Boston, Mass.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia.

Valves, Radiator.
C. A. Dunham Co., Ltd., Toronto.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

Valves, Pump.
Smart, Turner Machine Co., Ltd., Hamilton, Ont.

Valves, Safety.
Can. Fairbanks-Morse Co., Montreal.
Lunkenheimer Co., Cincinnati, O.

Valves, Throttle.
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Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

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Quaker City Rubber Co., Philadelphia, Pa.

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Goldie & McCulloch Co., Galt.

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Graton & Knight Mfg. Co., Montreal.

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Water Motors.
Elliott Co., Pittsburgh, Pa.

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Laurie & Lamb, Montreal.

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Wattmeters.
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THE POWER HOUSE

A Monthly Newspaper Devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigeration Machinery

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In time of safety prepare for accident

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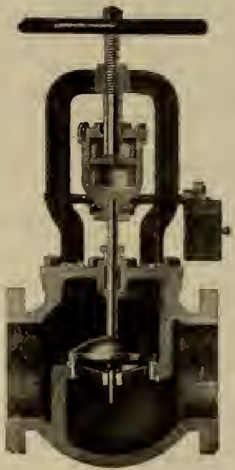
Its design is as simple as a common stop valve. Contrary to the usual practice it has an outside oil dash pot instead of an internal steam dash pot. It cannot stick.

And it has an indicator or telltale—you can see it work—you can test it by hand.



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make the Davis Class C the most dependable Stop and Check Valve ever designed. Many of the best equipped boiler rooms in the country are protected by them.

Let us send you a complete description and refer you to plants in your vicinity where you can see them on the job. Be prepared—write to-day.

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434 Milwaukee Ave. Chicago

Makers of Valve Specialties since 1875

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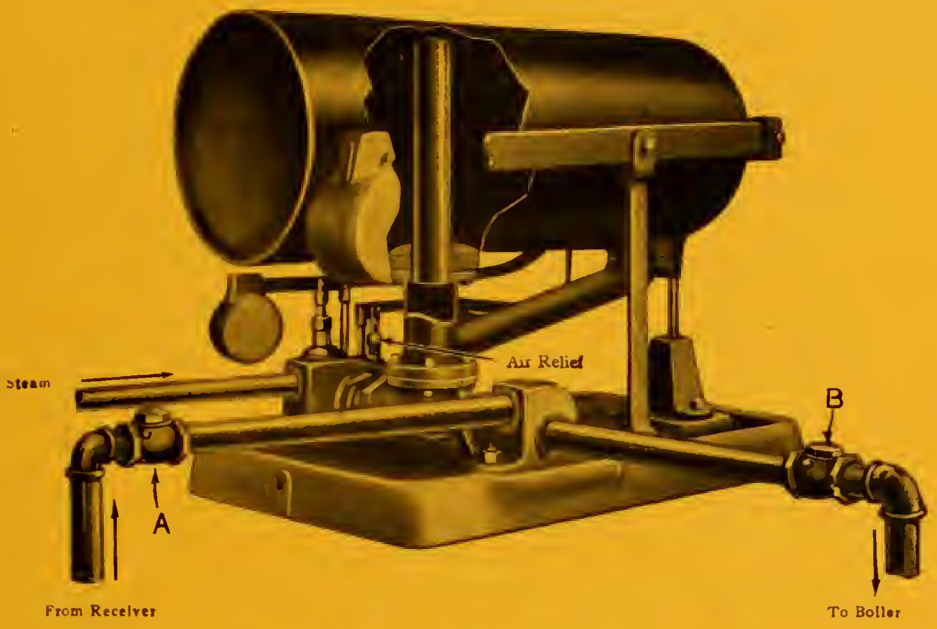
Nothing Mysterious about a Detroit Trap Every Working Part is on the Outside



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Some Facts You Should Know About Them

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Gauge or try cock

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"QUALITY" STEAM AND WATER SPECIALTIES

Model C safety valve, brass. Working pressure 200 lbs. per square inch.

have been the choice of the engineer who knows for over 30 years.

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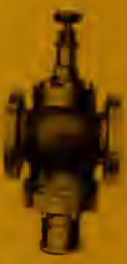
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Morrison automatic jet pit pump or cellar drainer, for draining wells, cellars, tanks, etc. Have been in use for over three years without requiring the slightest attention.

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Heintz steam trap will automatically control the condensation from heating coils, etc., without loss of steam. Simple in construction, convenient to install.

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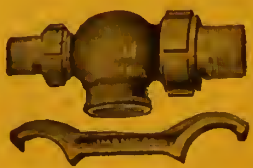
Gem ejector

J.M.T. gate valve

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That Means—

Perfect Regulation or Your Money Back

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are built and sold on the basis of quality—of economical operation and of permanent satisfaction to the user. The guarantee backs up every engine issued from our shops.

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Built in simple and compound units up to 700 H.P., it is the ideal installation for the isolated plant.

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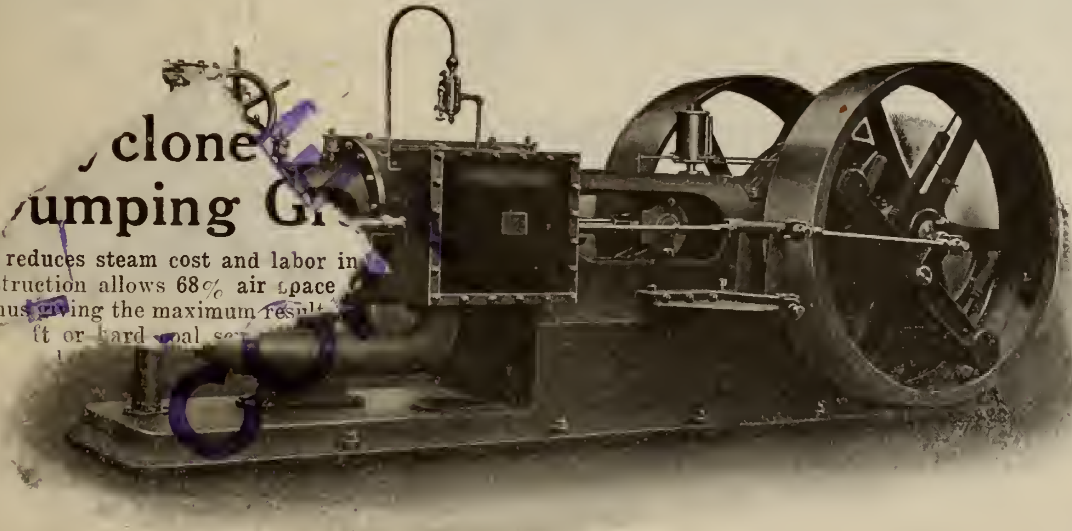

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cly reduces steam cost and labor in
s construction allows 68% air space
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THE WATEROUS ENGINE WORKS CO., Limited, BRANTFORD, CANADA

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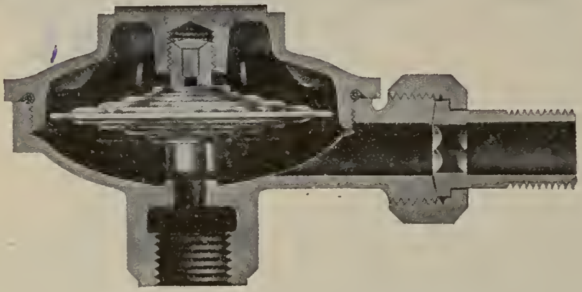
DUNHAM SYSTEMS of HEATING



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Mean Heating Satisfaction
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Dunham Radiator Traps—Prevent steam waste while allowing free passage of air and water of condensation from the radiator into return lines. This results in the one thing desired:—

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is a babbitt we strongly recommend for dynamos and motors.

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The idea upon which

Jenckes Boilers

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— that is why they stand up under hard service for an extra long period with but little cost for repairs.

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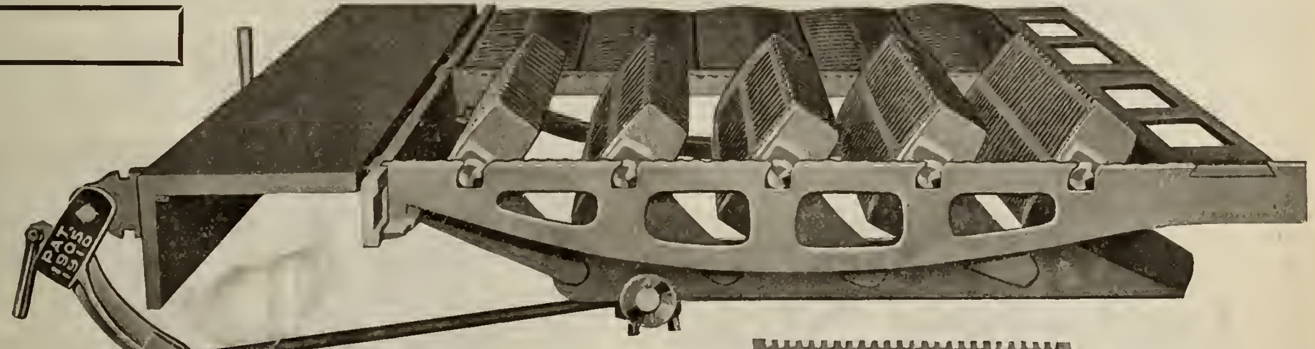

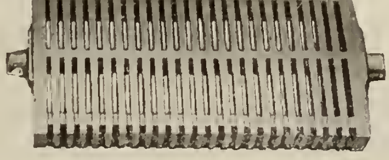

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Sole Manufacturers for Canada

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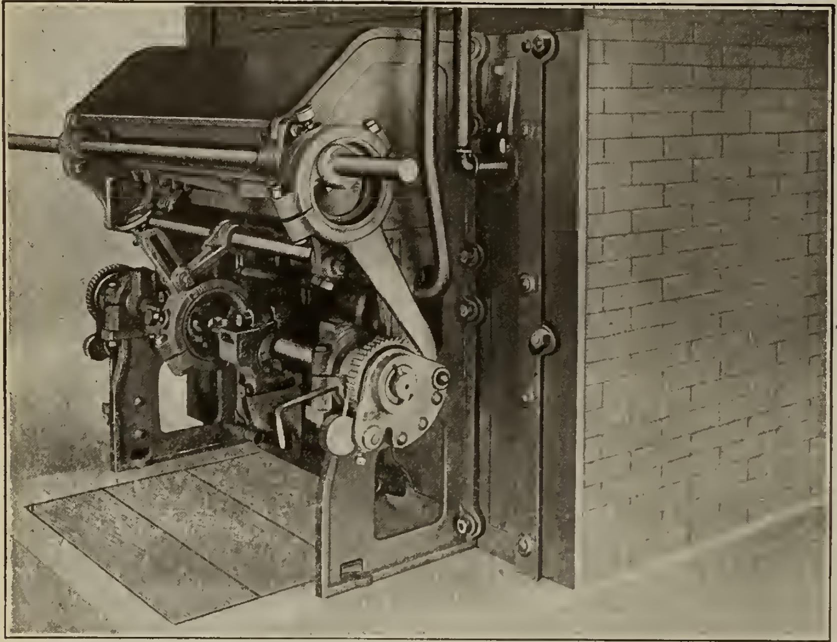

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Send for Bulletin F-106 P—a postcard will bring it.

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15,000 h.p. in use

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JONES
Underfeed Stoker

It is a **BIG** paying investment in the **SMALL** plant.

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Fuel saving from 15% to 25% interests most steam plant owners.

Hundreds of **JONES STOKERS** are to-day making these savings in plants like your own.

Have us report on the cost and merits of equipping your plant. The **JONES STOKER is made in Canada.** It is the simplest stoker built; fewer parts and none moving in contact with the fire; no grates; no losses through grate bars; no smoke.

May we send you descriptive booklet?

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St. Lawrence Sugar Refining Company

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Are you still allowing the Condensation to cool way down to accommodate an extravagant steam pump?

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Save the Costly HEAT UNITS

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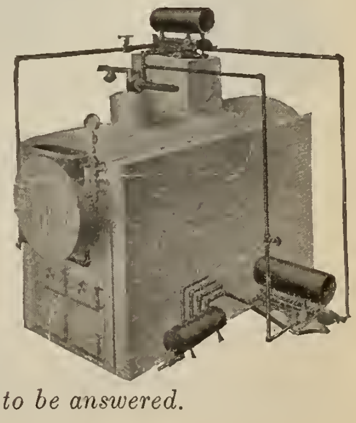
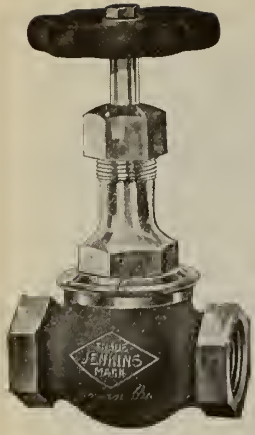
The "Morehead" Book explains the details fully. May we send YOUR COPY at once?

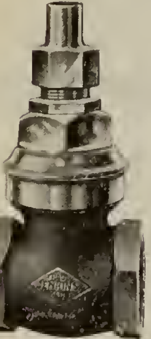


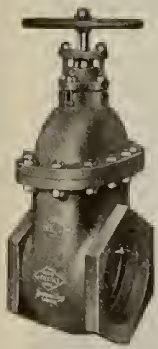
Canadian Morehead Mfg. Co.

Dept. "J"

Woodstock, Ont.







EVERY JENKINS BROS.' VALVE embodies the most modern improvements in valve construction. These valves are generally carried in stock by the leading dealers in mill supplies, or can be promptly furnished by them.

The Jenkins Bros.' guarantee of absolute satisfaction, replacement or money back, covering all valves bearing the Diamond Trade Mark, is equally effective whether the valves are purchased direct or through any dealer.

Behind every Jenkins Bros.' Valve is the accumulated knowledge of over forty years of constant study and designing and practical experience. And every valve bearing Jenkins Bros.' Diamond Trade Mark is backed by the iron bound guarantee that is *your* protection.

Further information and catalogue No. 8
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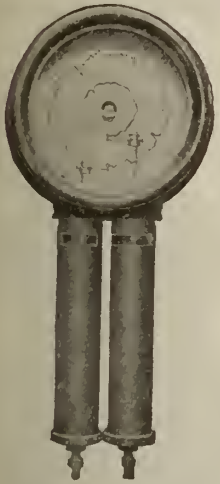
UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER



Record of CO2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO2** indicator at the **Boiler Front** holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.

CO2 Indicator for Boiler Front

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

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Reducing Valves

Pump Regulato
Balanced Valves
Damper Regulators

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Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

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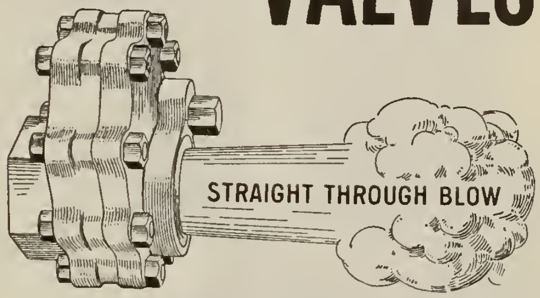
EVERLASTING

Blow-Off VALVES



"EVERLASTING" Blow-Off Valves will immediately end your blow-off leaks or troubles.

No Packing.

No Stuffing Box.

Self-Grinding Seat.

Self-Cleaning.

—NOTHING TO GET OUT OF ORDER.

Over 220,000 in use

The *Everlasting Valve*—endorsed by leading Consulting Stationary and Marine Engineers.

Accepted by Boiler Inspection Insurance Companies.

Approved by all Provincial Governments requiring High Pressure Valves and Accessories to be registered and recorded. Provincial Record Numbers furnished on request.

OUR GUARANTEE—Satisfaction guaranteed or money refunded within one year.

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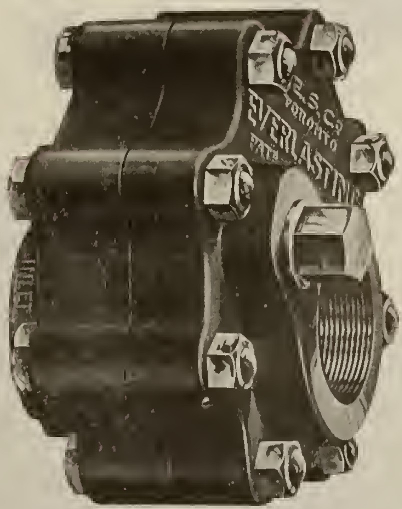

Write for New Catalog No. V-15

Look for this ☞MARK

The word "EVERLASTING" is on every genuine "EVERLASTING" Blow-Off Valve — it's your safeguard against imitations.

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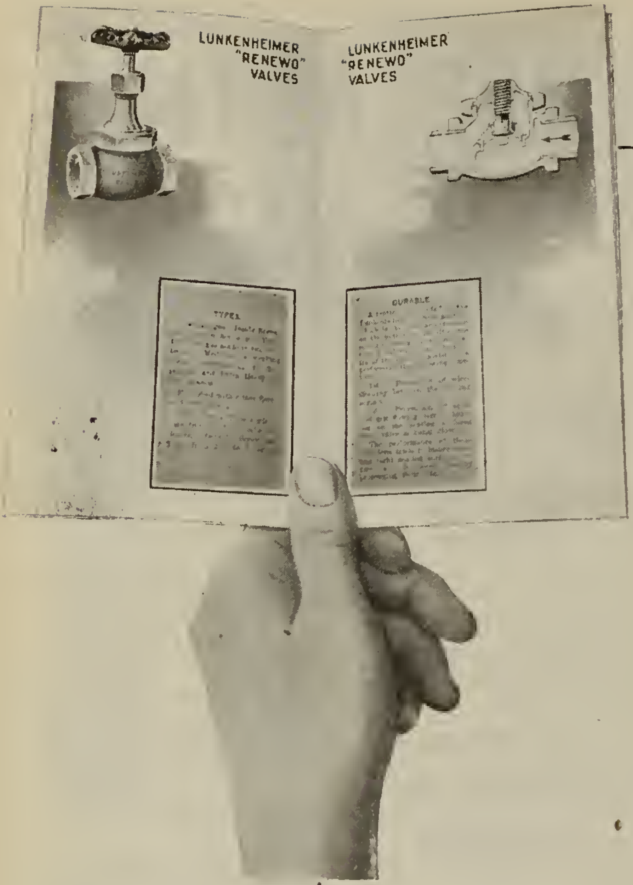


Illustrated and described in a unique and attractive booklet, — something different, — characteristic of the article illustrated and described therein.

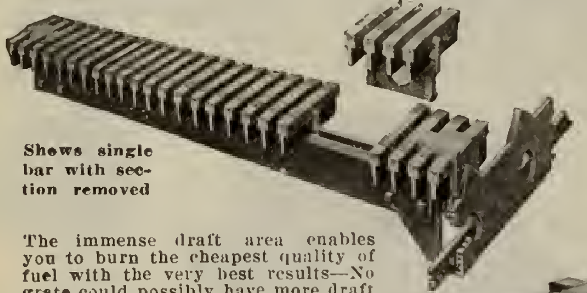
A copy may be had from your local dealer, or upon request we will send you one direct.

THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, O., U.S.A.

1-7-43

The McNaughton Grate

is GUARANTEED to increase the steaming capacity of your boiler 10% and reduce your fuel consumption 8 to 20%.



Shows single bar with section removed

The immense draft area enables you to burn the cheapest quality of fuel with the very best results—No grate could possibly have more draft area and leave any metal to support the fuel.

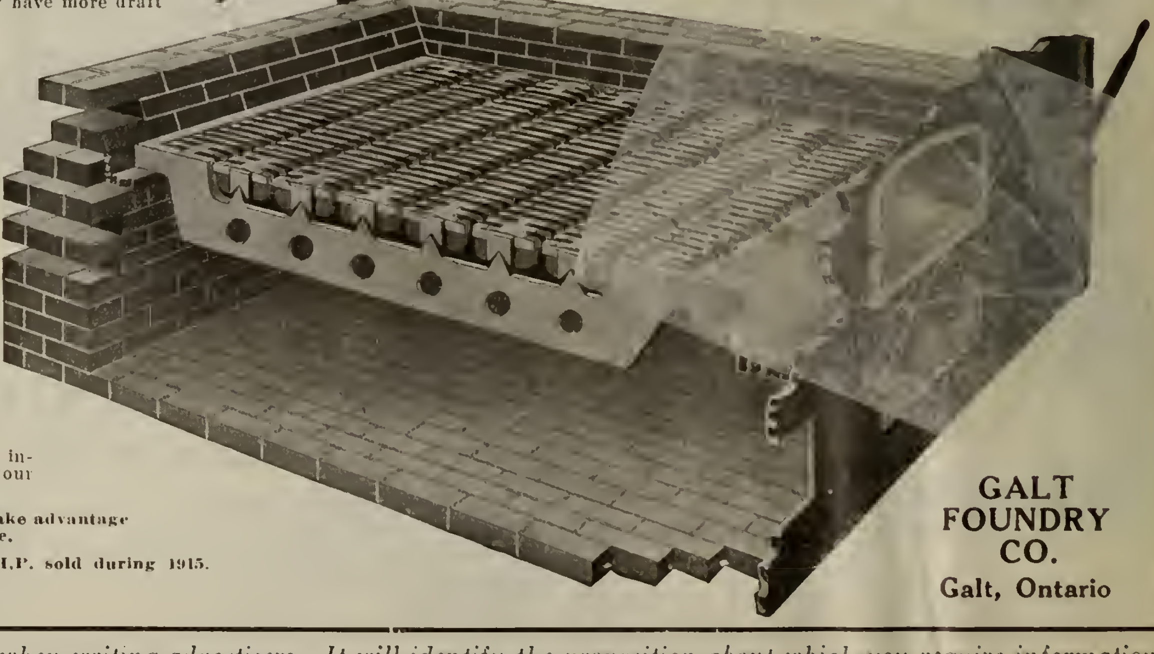
There is room for expansion between each section and no part of the bar is ever under any heat strain.

The whole set of grates and framework is self-contained and will fit in where any ordinary grates have been removed. Method of construction makes **repairs easy and ensures greatest durability.**

30 DAYS' FREE TRIAL. Installed when convenient to you and without interruption to your plant operations.

It will pay you to take advantage of this offer at once.

Nearly 20,000 H.P. sold during 1915.

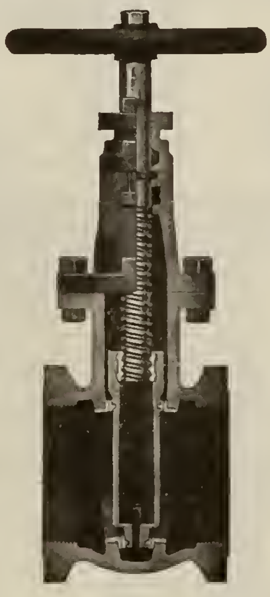


GALT
FOUNDRY
CO.
Galt, Ontario

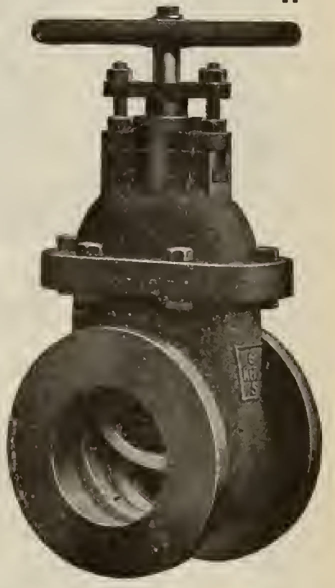
KERR

("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.



When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the " Best Valve." Write us for particulars.

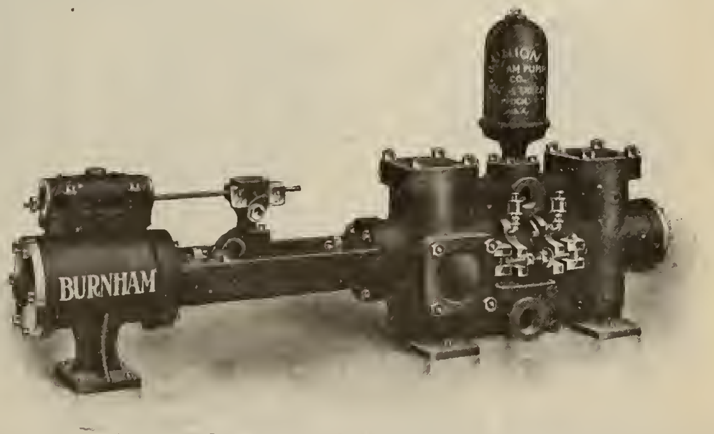
Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

BURNHAM BOILER FEED PUMPS

Burnham Inside Packed Boiler Feed Pump

Of the thousands of steam pumps installed every year a large percentage of them bear the name Burnham.

Burnham Pumps are endorsed by the leading Architects, Consulting Engineers and Heating Contractors as the best, simplest and most economical on the market.



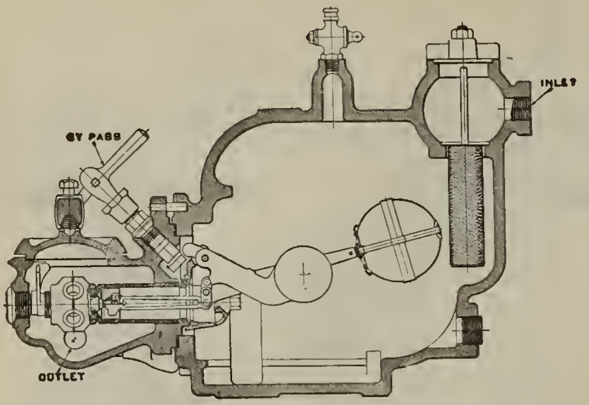
Burnham Outside Centre Packed Boiler Feed Pump

DARLING BROTHERS
LIMITED

Toronto MONTREAL Winnipeg

AGENTS:

Halifax St. John Calgary Vancouver



The Anderson Model "D" Steam Trap

has these points of Superiority

Both the valve and valve seat can be removed without breaking a steam joint or pipe connection.

The valve is always locked with at least three inches of water, making the escape of live steam impossible. The strainer and sediment chamber prevent sediment or scale getting into the valve.

A glass water gauge fitted to the trap makes it possible to ascertain at a glance whether the trap is working properly.

These traps will lift water against any back pressure 5 lbs. less than the pressure at the trap.

Made for high or low pressure or exhaust steam.

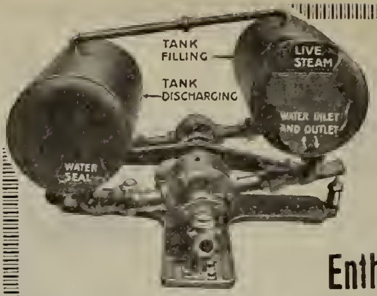
The Anderson Model "D" Steam Trap

Perfect in every detail, accurately built of materials best suited for the purpose. Every part absolutely interchangeable.

Complete with water gauge, by-pass, air valve, blow-off valve and sediment strainer.

Your request will bring you the fullest details by early mail.

The V. D. Anderson & Co.
1935 West 96th St., Cleveland, Ohio



Continuous Steam Drainage and Boiler Feeding

Enthusiasm Personified

best describes Mr. J. S. Haggerty, Brick Manufacturer, since installing the

CANADIAN DUPLEX

Return Steam Trap

(Two Traps in One)

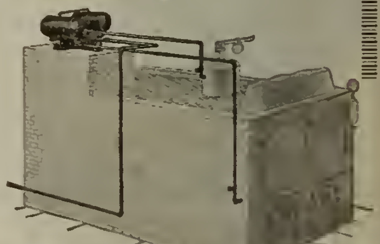
in his plant at Detroit, Mich.
In part he writes:
We consider our purchase of the Canadian Duplex Steam Trap a most profitable investment.
The drainage of the coils in our driers is now prompt and thorough, and the trap is giving PERFECT SATISFACTION.

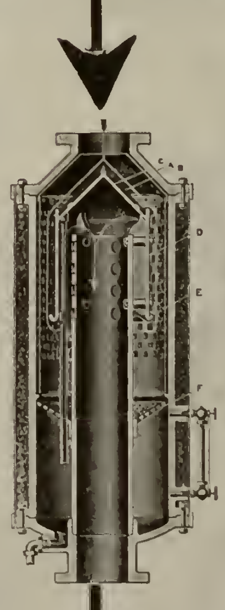
Respectfully yours,
J. S. Haggerty.

This modern trap for modern needs, which so completely convinced a manufacturing executive of Mr. Haggerty's type, will do the same for you.
For full details of our free trial offer and special bulletin address

Canadian Duplex Steam Trap Co.
Walkerville, Ont.

110





"About a Good Separator"

This is the title of a little book recently published and which you ought to read. It describes the engine wrecks and accidents of common occurrence fifteen years ago and how these wrecks and accidents were overcome by removing water from the steam. It will be sent to you free.

SWEET'S SEPARATORS

For Steam or Oil

Deliver live steam 98.8% dry and remove 99% of the oil in exhaust steam. Tests, proving these figures, are fully set forth in catalogue; 7,000 have been put into service in the past fifteen years and 3,500 have been sold on repeat orders. Built in all styles and sizes adapted to the needs of every power plant.

Write for descriptive catalogue.

DIRECT SEPARATOR COMPANY
820 South Geddes Street SYRACUSE, N. Y.

General Sales Agents:
Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Vancouver, Victoria.

DART
UNION PIPE COUPLINGS

Make Joints That Never Leak, Rust or Corrode

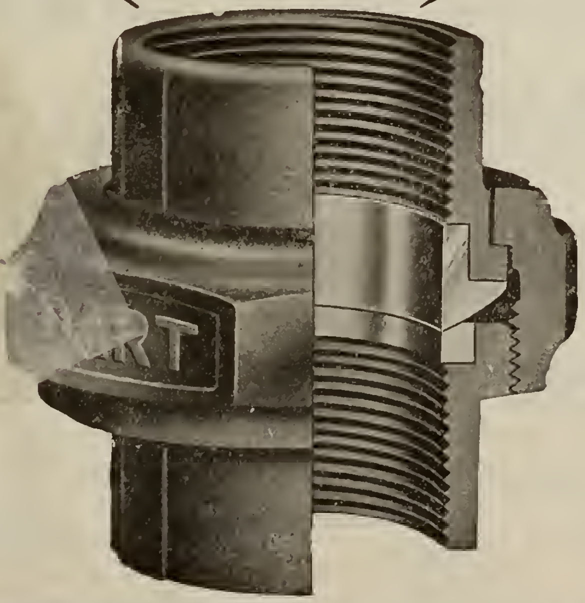
They make permanently tight connections because there is no deterioration at the joint and the heavy iron parts withstand all stress.

Dart Unions are easy to use—you can make the connection quickly whether pipes are in or out of alignment.

There's a style for every requirement.

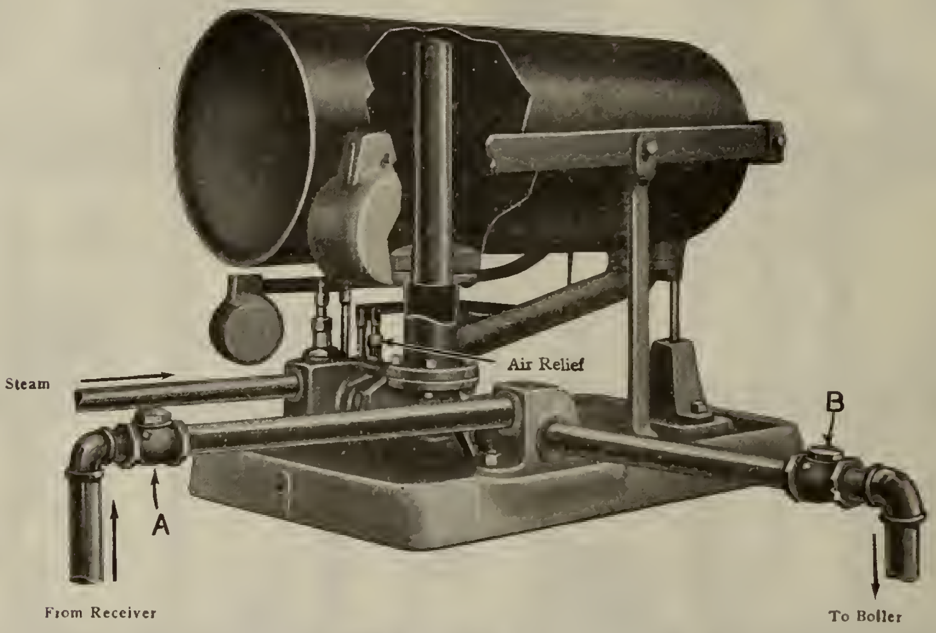
Sold by all jobbers

Dart Union Co., Limited
TORONTO, CAN.



Bronze to
Bronze
at the Joint

Nothing Mysterious about a Detroit Trap Every Working Part is on the Outside



"Detroit"

STEAM TRAPS

Some Facts You Should Know About Them

1. Nothing inside the tank to rust, corrode or give trouble—all working parts are on the outside and interchangeable.
2. Large water-handling capacities for space required. Will handle water at a higher temperature than a pump will lift.
3. Properly constructed — properly assembled and thoroughly tested before shipment.
4. Increase efficiency of steam coils or steam-heated machinery by keeping all lines free and clear of condensation.

These are only four of the reasons why "Detroit" Traps save money for the user. Trap catalogue No. 352 *gives all information—capacities—sizes. etc. Write the home office or any sales office.*

CANADIAN Sirocco COMPANY
LIMITED

WINDSOR, ONTARIO.

SALES OFFICES

S. S. Clarke,
605 2nd St.,
Calgary.

A. M. Nichol,
301 McGill Bldg.,
Montreal.

W. W. Hicks,
567 Banning St.,
Winnipeg.

Canadian Steam Specialty Sales Co.,
526 Traders Bank Bldg.,
Toronto.
Phone Main 5118

Canadian Sirocco Company, Ltd.,
604 Credit Foncier Bldg.,
Vancouver.

PEROLIN—Boiler Metal Treatment

MADE IN CANADA

PEROLIN BOILER METAL TREATMENT
MADE
IN CANADA
MANUFACTURED BY
PEROLIN COMPANY OF CANADA LTD
TORONTO
CANADA

Three years ago the Perolin Company of Canada, Limited, was formed to distribute PEROLIN—Boiler Metal Treatment to Canadian owners of steam power plants who desired that their Boiler Equipment should be absolutely clean and free from the scale that is formed by the action of the water.

PEROLIN—Boiler Metal Treatment has "done the job" under the most exacting conditions for many men and our customer friends have increased in such numbers as to warrant us manufacturing our product in Canada instead of importing it from the United States. By the elimination of duties the price of PEROLIN has been reduced, but the time-tested quality remains.

Mr. Reader, if you have any trouble with scale in your boilers, if they are not thoroughly clean, we want to have a talk with you. It will certainly be profitable to you.

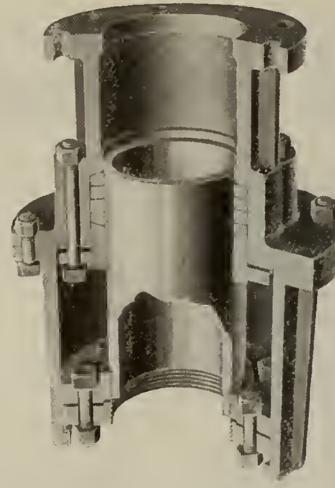
PEROLIN COMPANY OF CANADA, LIMITED

Office and Factory, 858 Dupont Street

TORONTO - - - - ONTARIO

North West Agents
CANADIAN SARCO ENGINEERING CO., LTD.
WINNIPEG, MAN.

British Columbia Agents
BAYFIELD & ARCHIBALD
VANCOUVER, B.C.



Ross Guided Expansion Joint

THE ROSS EXPANSION JOINT consists of the well-known slip joint, with the improvement of a removable guide. This guide eliminates the strain that might be placed on the joint due to sagging of the pipe line, and thereby removes the only reasonable objection there has been to the slip joint type of expansion joint.

THE ROSS EXPANSION JOINT may be repacked, or packing adjusted, without removing it from the pipe line. No special tools are required. On account of the long traverse of the ROSS EXPANSION JOINT, the minimum number are required.

Built in sizes up to 24 in., and for working pressures up to 225 pounds.

MANUFACTURED BY

Alberger Heater Company

BUFFALO, N.Y. CHICAGO, ILL.

GENERAL SALES AGENTS

The Canadian Fairbanks-Morse Company, Limited

St. John
Quebec
Toronto
Winnipeg
Calgary
Vancouver

Montreal
Ottawa
Hamilton
Saskatoon
Edmonton
Victoria

CFM

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

"Pays for Itself in 44 Days"—

How many of your boiler-room tools really pay for themselves? And those that do—how long does it take them to make good?

November 5, 1915.
The William B. Pierce Co.,
Buffalo, N.Y.
Gentlemen:
Enclosed please find our check, which place to our credit for the DEAN BOILER TUBE CLEANER.
In regard to the work of the Cleaner, we cut out six flues—4 out of No. 2 boiler and 2 out of No. 3. All but one leaked at the welds and one leaked at the seam.
The President of the Company was here on the 2nd. I explained the Cleaner to him and showed him 7 big wheelbarrows of scale that we had taken out of 2 boilers (No. 1 we did not clean, as we had taken out all the flues). He seemed pleased, but thought it was a big price, but he has never had any experience with boilers and couldn't see the benefit.
However, I know I can convince him, as we are now making our ice for the winter, and are saving about 1,600 LBS. OF COAL EVERY 24 HOURS—QUITE AN ITEM AT $2.15 PER TON.
Yours respectfully,
NEVADA CRYSTAL ICE AND COLD STORAGE CO.,
Per J. S. Wachtel,
Manager.

This tool — the Dean Boiler Tube Cleaner — costs this plant just $75.00 — and it saved just $1.72 in coal per day! Nor does this include the increased steaming capacity of the boilers, longer life of the tubes and the extra "snap" to the boilers.

Your boilers are no different—your plant is about the same—your conditions exactly parallel. Why shouldn't you cut your coal cost the same way?

You can—with the Dean Boiler Tube Cleaner.

November 11, 1915.
The William B. Pierce Company,
Buffalo, N.Y.
Gentlemen:
Yours of the 8th to hand. In reply will say that you are welcome to publish the letter I wrote you in regard to the DEAN CLEANER, as we have the proof for every word I wrote you.
WE WILL USE NO MORE COMPOUNDS IN OUR BOILERS; THE DEAN CLEANER IS MUCH CHEAPER.
Very respectfully,
Per J. S. Wachtel,

To you who use compounds and "magical" chemicals supposed to remove scale from the feed-water, this letter should be significant! Observe that the plant used compounds and yet took out 7 wheelbarrows full of scale with the Dean! Of course, the Dean is cheaper!

The Dean operates by air or steam in any type of boiler. It can be fitted for use in tubes of different sizes and interchangeably in water-tube and fire-tube boilers. In construction, it is simple; in strength and power, remarkable; in ability to remove scale, unequalled.

Manager.
December 4, 1915.
The William B. Pierce Co.,
Buffalo, N.Y.
Gentlemen:
Enclosed find check for balance due on the Dean Boiler Tube Cleaner recently purchased.
The reason I did not mail this before is that I was waiting for the Boiler Inspector to arrive, thinking that I might send you some news. He was here to-day and says that our boilers are in better condition than he ever found them before. The flues at the back end are cleaner than he ever saw them; scarcely any scale is left on them.
I know we will save the price of this Cleaner every sixty days we run our boilers.
Yours very truly,
NEVADA CRYSTAL ICE & COLD STORAGE CO.
J. S. Wachtel,
Manager.

Boiler Inspectors who know invariably recommend the Dean Cleaner—because they realize that it is the only tube cleaner that thoroughly removes the heavy scale that forms at the headers, the most dangerous scale of all. What is price compared to this kind of efficiency?

You may try the Dean Cleaner right in your own boilers, if you want to—without cost or obligation to buy. Just write us, either office, and say, "Send me a Dean for free trial" (and be sure to give size of your tubes and type of boilers).

THE WM. B. PIERCE CO.

153 El ott Street
O, N.Y.

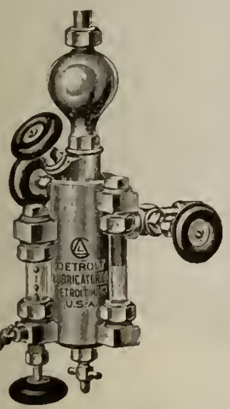
201-2 Coristine Bldg
MONTREAL, Que.

Representatives in Hamilton, Winnipeg and Vancouver

Insist on "Genuine Detroit" Lubricators

Since 1867 the Detroit Lubricator Company has maintained the leadership in the manufacture of an efficient lubricating device for every purpose.

Over half the lubricators in the world are Detroits, and this demand for "Genuine Detroit" Lubricators is the demand for *quality*.



Naturally a product with the reputation of the Detroit has many imitators—some of the imitations being sold on the strength of looking like the Detroit and some as being "just as good as the Detroit."

For your protection we mark every package with the above trade-mark—look for it and see that you get the genuine.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

Largest manufacturers of lubricating devices in the world

ENGINE LUBRICATION

that produces increased power output, with better bearing conditions, no waste of lubricants, is what you secure when

ALBANY GREASE

is used. We'll gladly send you enough to try on your engine or any bearing in your plant. Write now, while you're interested.

Your dealer sells Albany Grease ; if not, order direct

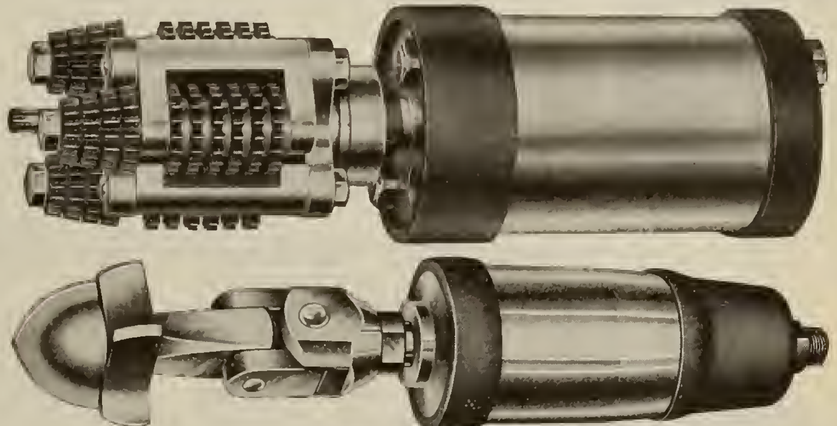
Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868

ROTO TUBE CLEANERS

Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.
The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.

THE ROTO COMPANY
Write for Catalog HARTFORD, CONN.



Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

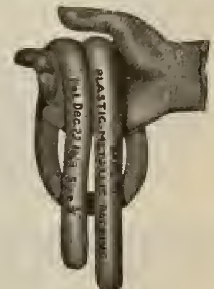
LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.

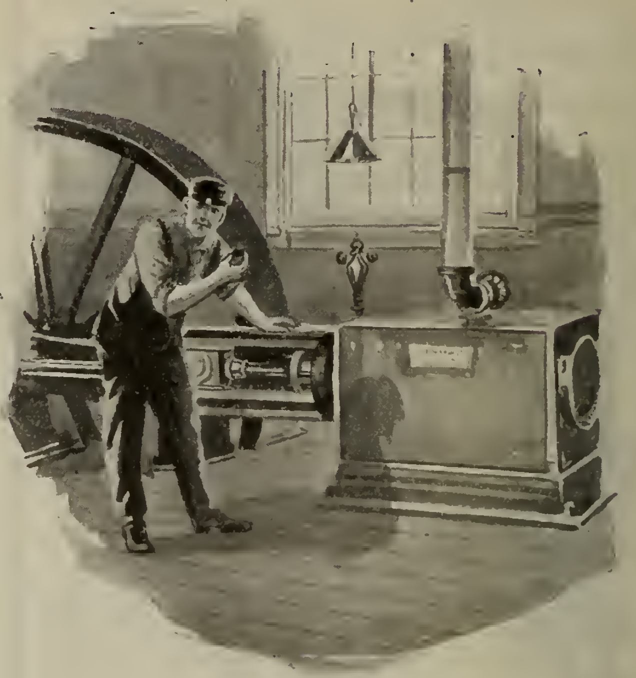
MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless



Any Quantity sent on APPROVAL

"I Just Use My Fingers"



A Bridgeport, Conn., engineer writes: "I have used P. P. P. on scored rods, and by just using my fingers to screw up the stuffing-box, the rods were made tight and stayed tight longer than with any other packing."

Doesn't it stand to reason that a packing that can be made tight enough without the use of a wrench to resist maximum pressure—without leaking or blowing—*cannot* cause friction?

You are a practical man, therefore no other argument should be necessary to convince you that you can save both power and trouble by using

DANIEL'S ROD PACKING

P.P.P.

FOR STEAM, AMMONIA, WATER, AIR

Reg. U. S. Pat. Off.

We believe that the best possible advertisement for an article is found in the results secured in actual use—for this reason, we quote from the letters of users.

"I can say for P.P.P. Packing that about six months ago I was having trouble with packing in the piston rod stuffing box. A salesman came into the engine room and I told him my troubles, and he recommended P.P.P. I ordered a box and packed the rod that night, following instructions closely. The same packing is in there now, and when it comes out, some more goes in."—*Washington Engineer.*

"We use P.P.P. exclusively in our plant, and I will say that it has proved to be the best and, in some cases, the only packing that ever gave satisfaction. We could not get along very well without the old reliable Daniel's P.P.P. Packing."—*Massachusetts Engineer.*

"I have used Daniel's P.P.P. Rod Packing for years, and I believe it is the best all around packing on the market to-day."—*Michigan Engineer.*

"I take pleasure in saying a good word for your P.P.P. Rod Packing and also EBONITE Sheet Packing. I have used both with fine results for several years."—*Wisconsin Engineer.*

"I use your P.P.P. Rod Packing, and it is the very best I ever used. It proves its merit by use. I recommend it to other engineers."—*Ohio Engineer.*

You can prevent a lot of unnecessary trouble for yourself, and save on packing and coal bills by using the original Daniel's P. P. P. Rod Packing. There's a dealer near you—order a sample lot TO-DAY.

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS
PHILADELPHIA, PA., U. S. A.

Johns-Manville

JOHNS-MANVILLE SERVICE

COVERS THE CONTINENT

© H.W. J-M CO.

The Canadian H. W. Johns-Manville Co., Limited
Toronto Montreal Winnipeg Vancouver

KNOWLEDGE of equipment sets the pace. We often hear about "the man behind the throttle." But more than mere handling the throttle is necessary in the management of a successful and efficient plant. The steam engineer must know equipment—that is of proven serviceability and that it is backed up by recognized business stability.

J-M Responsibility, backed by J-M Service, stands behind every J-M product. J-M Service "Covers the Continent" and is available everywhere. Take advantage of it in your plant equipment purchases.

J-M Universal is folded up like a clinched fist and it's hard to pull apart

It is a good deal harder to pull a man's knuckles apart than to separate his extended fingers, because the leverage is increased greatly in the latter case and the extended fingers are weaker against side pull.

Roughly, this is an analogy of the difference between **J-M Universal** with its folded construction and ordinary hydraulic packing which may be compared to the extended finger example.

The side swiping that any inside piston or plunger packing is subject to is really a side-on pull, and it is this pull against which ordinary laminated packing is weakest. But J-M Universal can stand this. It's built to stand it—all in one piece—folded on itself again and again.

You haven't any idea how long inside packed pumps will stay tight until you have made a century run with this new design, better service packing. Try it.

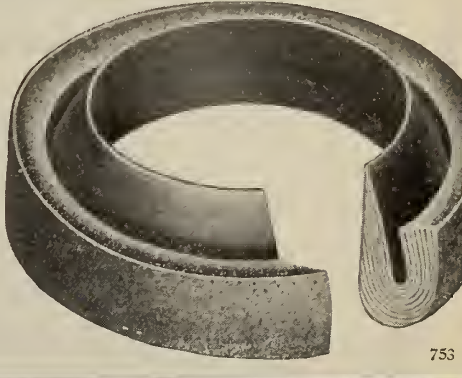
More than a good packing—because they actually improve plant efficiency—J-M Sea Rings

When you pack a rod or plunger with ordinary packing, you must make the stuffing box leak-proof against the greatest pressure to which it will be subjected, regardless of the fact that in all machines whether engine, compressor or pump, the actual fluid pressure against the packing varies during each stroke.

In other words there is a constant power loss as well as rod and packing wear due to this constant, maximum packing pressure, a great part of which is pure waste.

It is by correcting these evils that the automatic action of J-M Sea Rings save packing wear, rod wear and frictional power losses—because they are actually operated by the fluid pressure behind them. They pack just as tight as necessary—no more—no less and regardless of the pressure or its variation.

You can improve every rod in your plant by adopting this packing and spend the time you formerly spent on shut-downs on more valuable work. Write—right now to any branch and get all the facts.



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Service and Responsibility

The Strength and Lubricant of

TRADE MARK

"PALMETTO"

REG. U.S PAT. OFFICE

causes it to outlast all other packings and gives perfect satisfaction under most difficult conditions of service.

STRENGTH is secured by strands of high tensile strength braided up in layer upon layer construction.

LUBRICANT for keeping the packing soft and doing away with rod friction is secured from the graphite grease forced into each strand before braiding.

GREENE, TWEED & CO.

109 Duane St. SOLE MANUFACTURERS New York

Canadian Distributing Agents:
The CANADIAN FAIRBANKS-MORSE CO., LIMITED
Montreal, Ottawa, St. John,
Toronto, Winnipeg, Calgary,
Saskatoon, Victoria,
Vancouver

Let us send you a free working sample.

GARLOCK

NINE HUNDRED SHEET

Is unsurpassed for superheated steam joints.
It is equally well adapted to air, acids, ammonia,
Or any severe condition where sheet packing is required.
It is made of the highest quality of long fibre asbestos,
And is built up into sheet form under tremendous pressure,
Thus securing great toughness, flexibility and tensile strength.
It is not affected by extremely high pressures and temperatures,
And does not require following up after gaskets have been applied.
Joints can be opened as often as desired without injury to gaskets.
This sheet is furnished in all thicknesses from 1-64 to ¼ inch.
Gaskets of all shapes and sizes can be cut by us from Nine Hundred Sheet.

The Garlock Packing Company, Hamilton, Ontario

BRANCHES:

Montreal, Quebec - - - 342 St. James St.
Toronto, Ontario - - 404 Continental Life Building.
Winnipeg, Manitoba - - - Galt Building.

Beauty of Belting is often "skin deep"

Do not be misled by finish when buying a new belt—finish often covers an inferior quality.

Make it "safety first" by looking up the past and present service of a belt before buying it.

Make a thorough investigation of

GENUINE OAK

REGISTERED TRADE MARK

This trade-mark guarantee is on every piece of D. K. McLaren's leather belting. Look for it.

D. K. McLaren's
Genuine British Oak-Tanned
Leather Belting

We'll gladly put you in touch with users.

D. K. McLaren's Belting is recognized as the best economy, because it delivers the greatest amount of power, is very durable, and minimizes power losses by its great cling and little stretch.

Many of Canada's largest power plants are steady users.

Write us to put you in touch with them now.

D·K·McLAREN
LIMITED

Head Office and Factory: 351 St. James St., Montreal, P.Q.

TORONTO, ONT.
200 King St. West

ST. JOHN, N.B.
64 Prince William St.

VANCOUVER, B.C.
847 Beatty St.

ENGINEERS SUPPLY CO., 123 Bannatyne Ave. E., Winnipeg, Man.

LEATHER TANNERS AND BELT MAKERS

Home Office and Factory
of
The Graton & Knight Mfg. Co.
Manufacturers of

G&K 1851

LEATHER BELTING
- Spartan (Steamproof)
- Neptune (Waterproof)
- Special Planer (Waterproof)
- Heart, GraKnight
- GraKnight Dynamo

SPECIAL BELTS
- Solid Round
- Twist Round
- Motorcycle
- Auto Fan
- "V" Shaped, etc.

LEATHER

LACE LEATHER

BELT DRESSING

BELT CEMENT

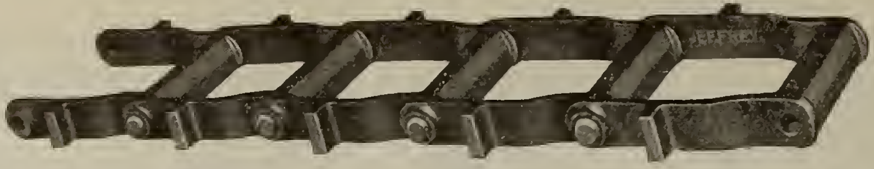
LEATHER SPECIALTIES
- Automobile Leathers
- Packings
- Pump Leathers
- Gaskets
- Washers
- Halters
- Hand Leathers
- Mittens
- Leggins
- Aprons
- Shafting Rings
- Horseshoe Pads

STRAPS
- Mill, Blanket
- Trunk, Skate, etc.

SHOE SUPPLIES
- Insoles, Outsoles, Counters
- Box Toes, Welting

The Graton & Knight Mfg. Co.
OAK LEATHER TANNERS AND BELT MAKERS
Worcester, Massachusetts, U. S. A.

Representatives in Canada
The Canadian Fairbanks-Morse Company, Limited. St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.



Note the Extra Long Wearing Surface of Pins.

Extension Lugs protect the Heads of Pins.

Inexpensive to Install—Operate—Maintain

The **JEFFREY "RELIANCE" DRAG CHAIN CONVEYER** readily lends itself as an Economical Conveyer for the handling of Ashes, Clinker, and other Abrasive Materials.

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Installations pictured here are fully described in Bulletins Nos. 154-4 and 155-4. Send for copies.

The Jeffrey Mfg. Co.
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Handling Ashes in basement under boiler room of the Otis Elevator Co., Yonkers, N.Y. Operates in an extra heavy Cast Iron Trough set in cement trench.

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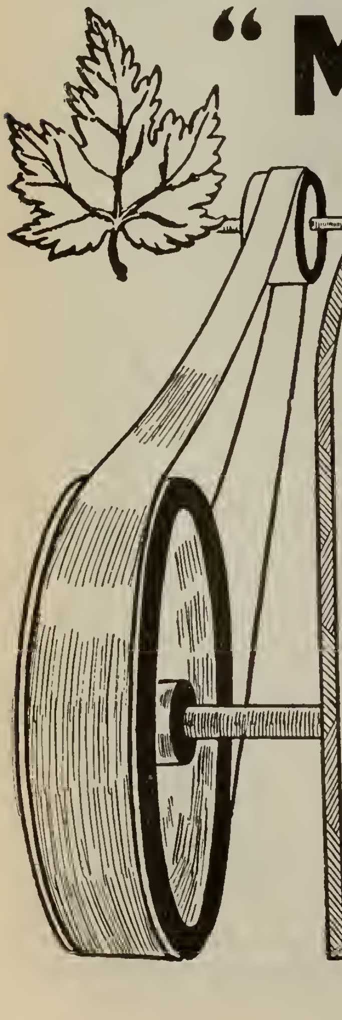

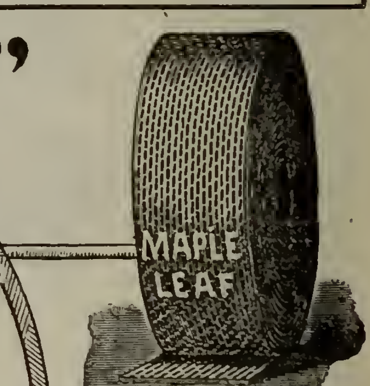

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These improvements add 25% to the usefulness of the tool.

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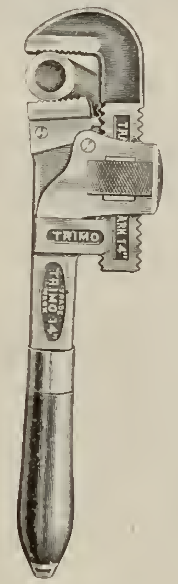

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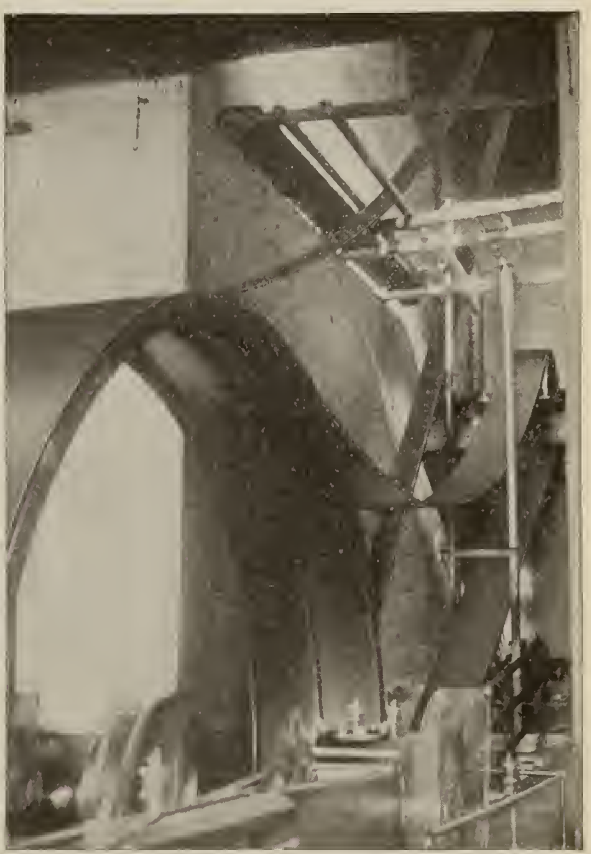

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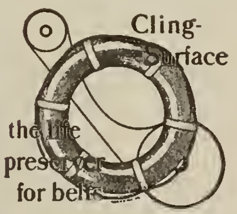
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With best wishes, I remain
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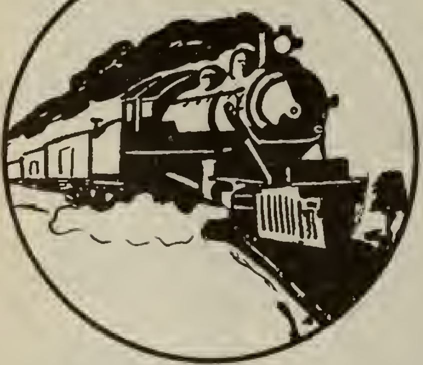

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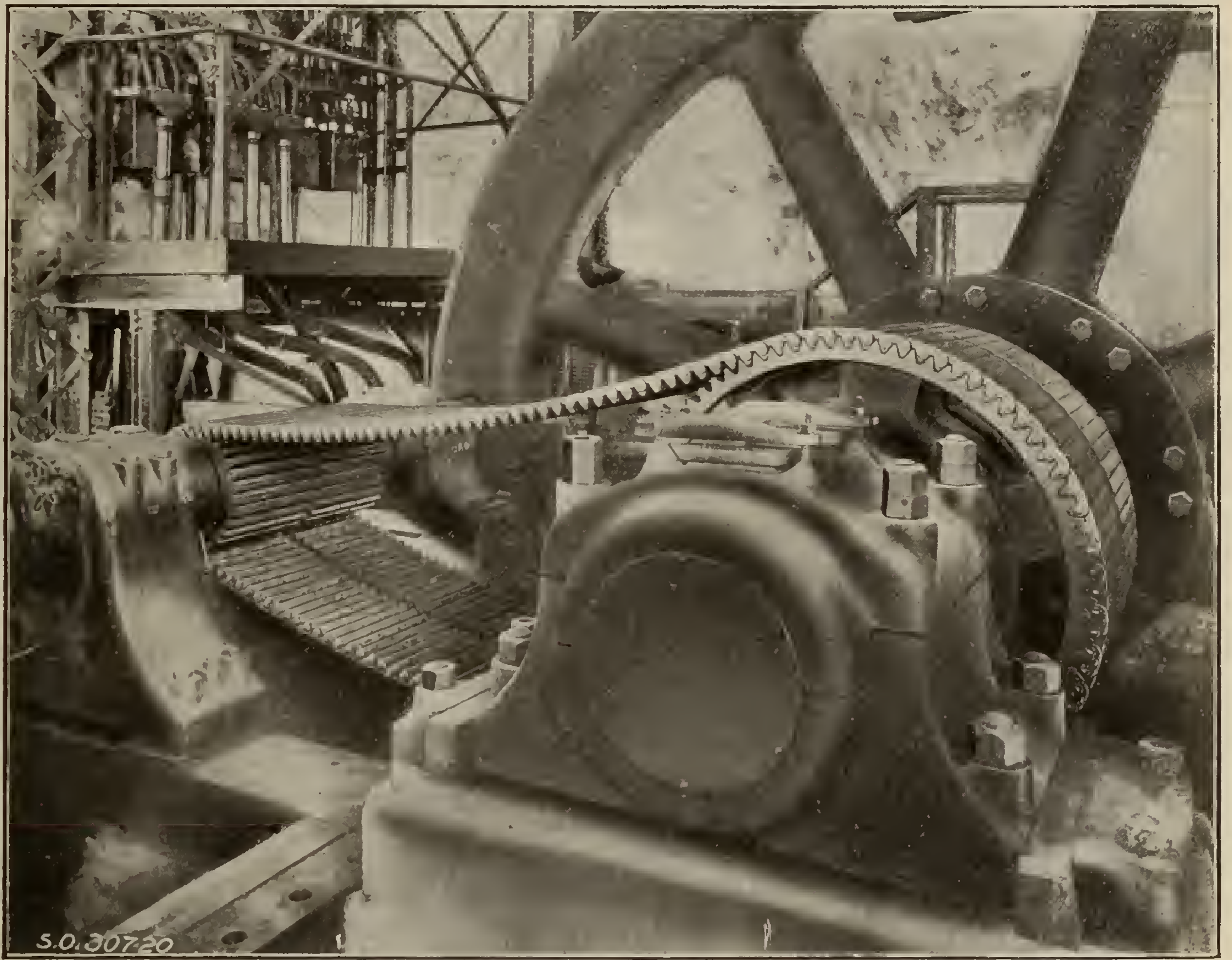

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600 H.P. MORSE Silent Chain Drive from electric motor to 18" Merchant Mill Rolls.

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What is being done with large power (100 H.P. and upwards) chain drives is clearly illustrated by this and many other installations shown in our latest publication, No. 14, "A CHAIN OF EVIDENCE."

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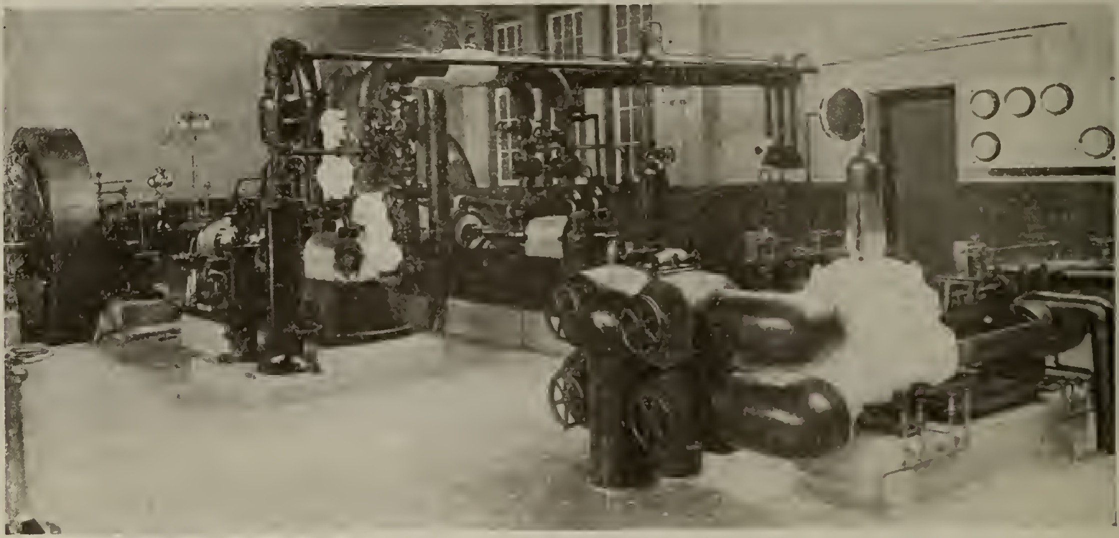

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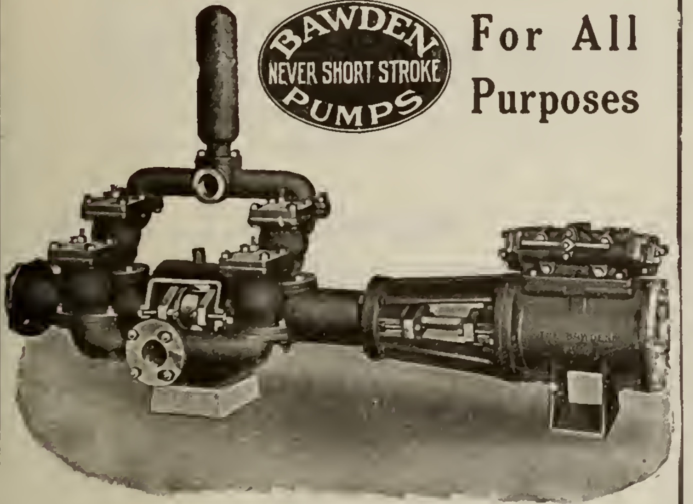

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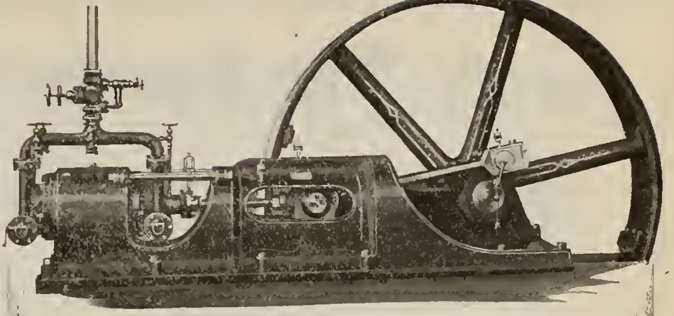

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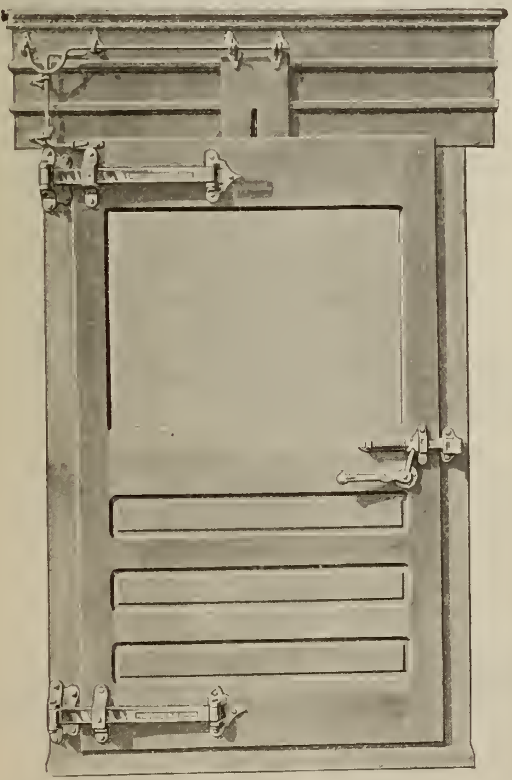

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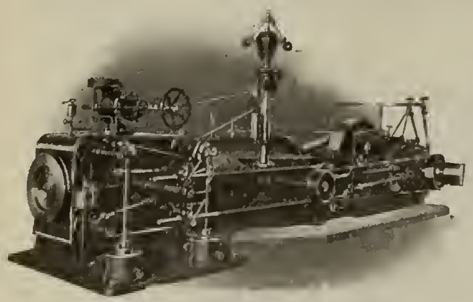

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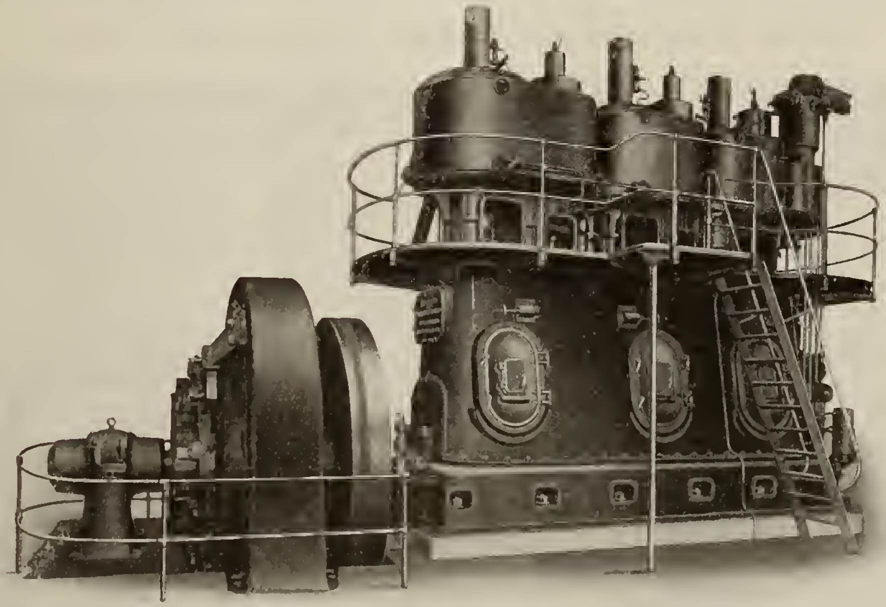

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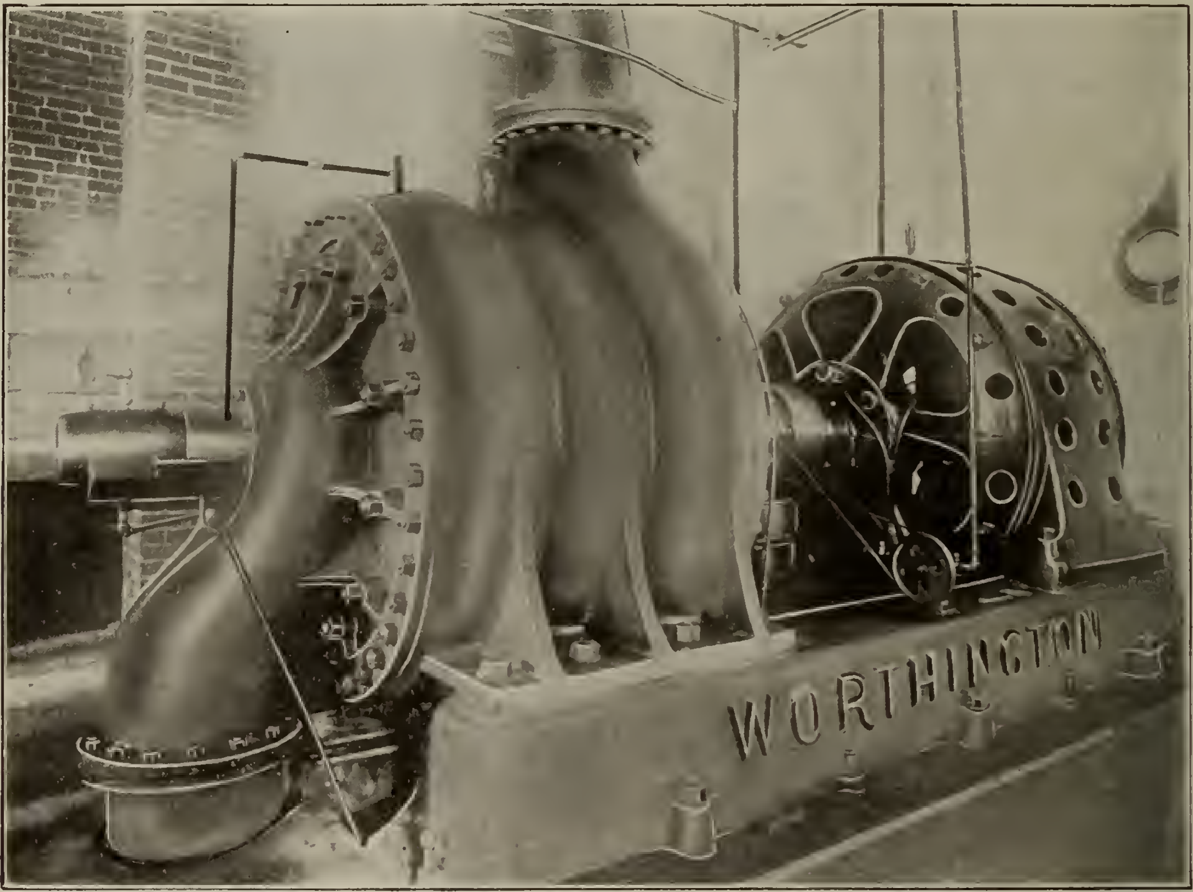
Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps—centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment
of their Boiler, Feed and General Service Pumps

The Publisher's Page

By B.G.N.

¶ Did you make any New Year Resolutions? Have you kept them all or only the easiest?

¶ How about that one of not leaving till to-morrow what you can do to-day?

¶ You are not the only man who has a lot of things which ought to be done to-day. Most men have a lot of things to do. but do not always have the things to do them with.

¶ Try this as a daily tonic and see how quickly you clean up the loose ends around the engine room: Spend a little time looking over the ads. in Power House every issue. Keep a note-book beside you and jot down every thought that occurs to you regarding your work.—New or Better Packing wanted!. Belt dressing. Belt fasteners or a lacing machine! Spare steam gauges to be tested! Last lot of waste not up to sample! Oil filter needs cleaning and one or two units renewed! What about scrapping these old worn wrenches that mean bruised knuckles every time they slip?

¶ Tell the Boss the winter's work has been hard and when the weather opens up business will be still better and the work harder. Say you want to insure your own time and his bank account by "being prepared" to prevent a total shut down.

¶ Twenty dollars' worth of supplies on hand are worth more than twenty thousand dollars' worth in the store after the store's closed for the week-end.

¶ Recall the last half-dozen cases of trouble that some of your pals have had and see if you have benefited by their misfortune. The same thing may not happen to you, but if it did are you ready for it or must all the boys lose a half day's pay 'cause you didn't think it might happen. Have you any babbit handy? No? Well now, there you are!

THE POWER HOUSE
143 UNIVERSITY AVENUE, TORONTO, CANADA

POWER EQUIPMENT

Steam Engines and Turbines, Return Tubular and Water Tube Boilers

The isolated plant is the most reliable, the power is always there when you want it, and according to tests which are continually being made under various conditions, it is also the most economical.

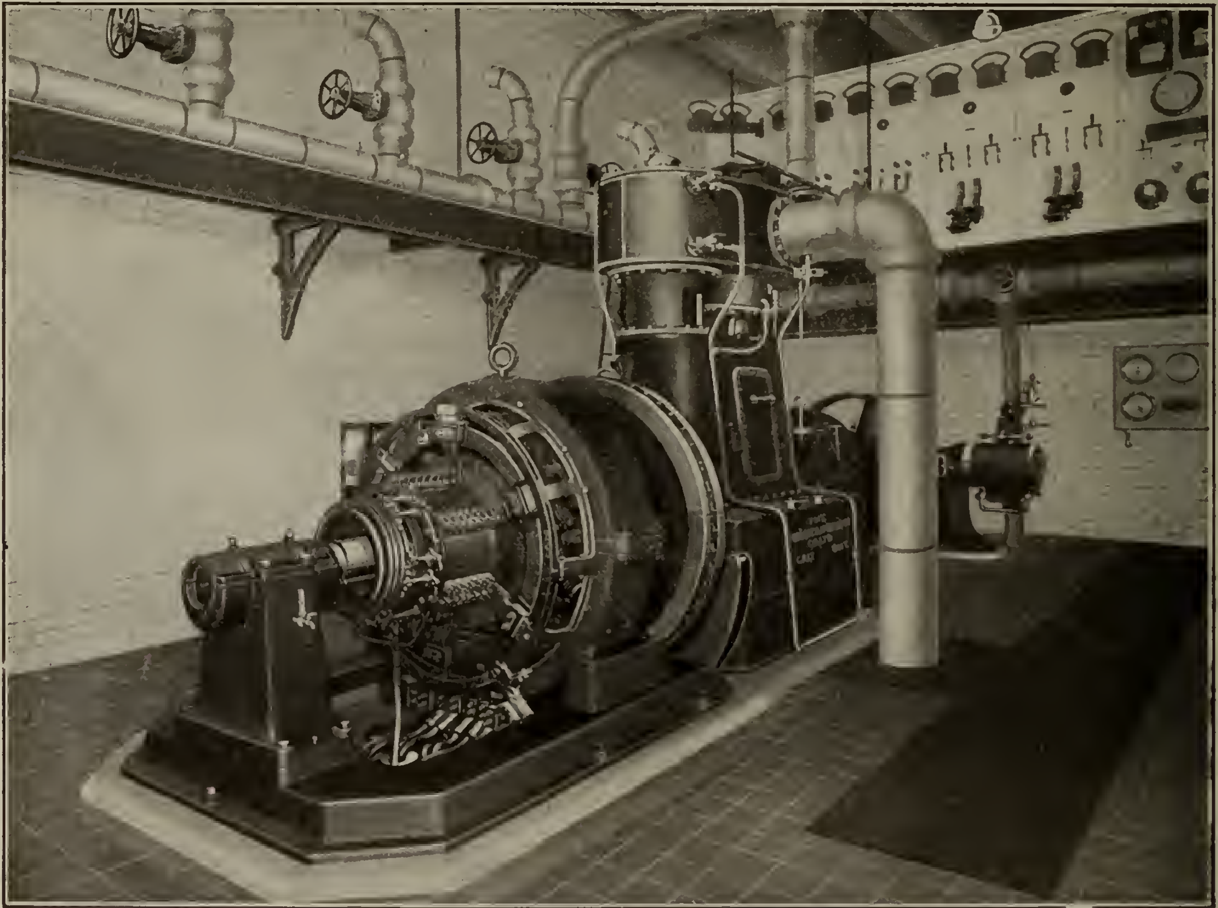


Illustration shows a portion of the Engine Room in connection with the new Toronto Technical School, which is equipped with G. & McC. Vertical Steam Engine of 250 K.W. capacity, and also an Ideal High Speed Steam Engine of 50 K.W. capacity. In addition to these we are supplying a small 15 H.P. Steam Turbine for experimental purposes.

We build Engines and Boilers to suit all conditions of service. Ask for our Catalogues, Specifications, Prices, etc.

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Low Level Pumping Station, Montreal City Waterworks

Staff Article

The origin and development of this plant, which supplies the greater portion of Canada's metropolis with water for domestic and other purposes, is not only interesting, but serves to indicate in an impressive manner the constant and periodical growth of waterworks pumping equipment in a large city. The evolution of modern types of machines is clearly indicated.

THE main, or as it is usually termed, "Low Level" pumping station of the City of Montreal water works department, is probably one of the finest examples in this country, of the gradual modernization of an equipment that, while originally of ample capacity for the purpose for which it was designed, was forced to keep pace with the unprecedentedly rapid growth of our largest city.

The water supply was originally drawn from the St. Lawrence river, at a point 5½ miles above the plant and some distance above the Lachine Rapids, through an open canal which gave a head of about 20 feet at the present location, where a dam and hydraulic development furnished sufficient water-power to pump enough water for the Montreal of the fifties and early sixties.

In 1868 when the limits of the water power had been reached, the first steam installation was made, as an auxiliary to the hydro-power station, and an addition of 10,000,000 gallons to the daily capacity was deemed ample for years to come.

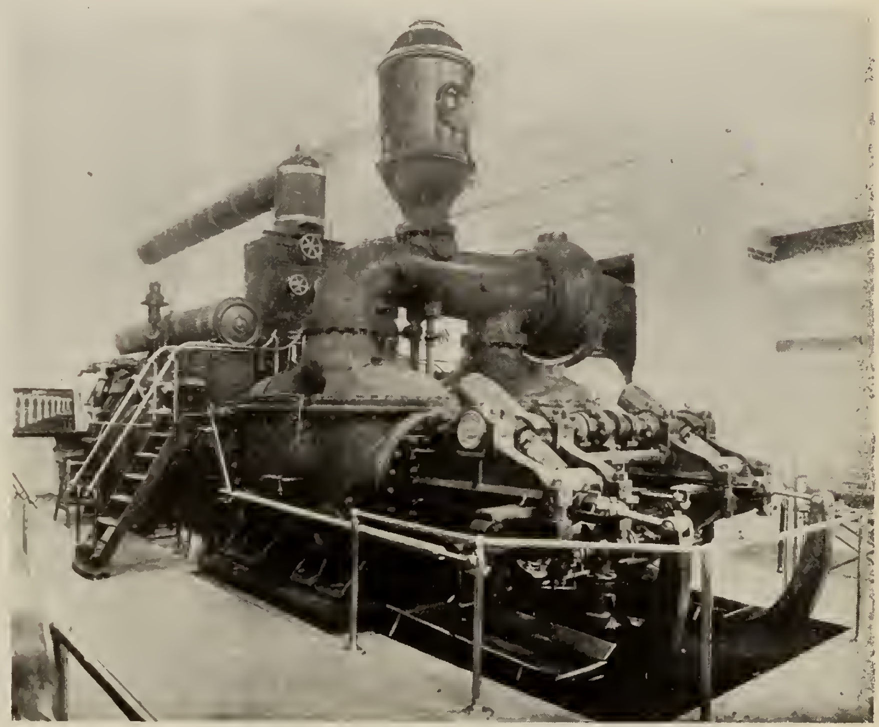

FIG. 2. WORTHINGTON DUPLEX HIGH DUTY STEAM PUMP.

In the eighties began the real growth of Montreal which was so much more rapid than anticipated, that from 1893 the authorities found themselves called upon to furnish water each year to from 20,000 to as many as 45,000 additional new inhabitants; a condition that had been almost impossible to foresee, until at present the municipal service is capable of furnishing a population of 750,000 souls.

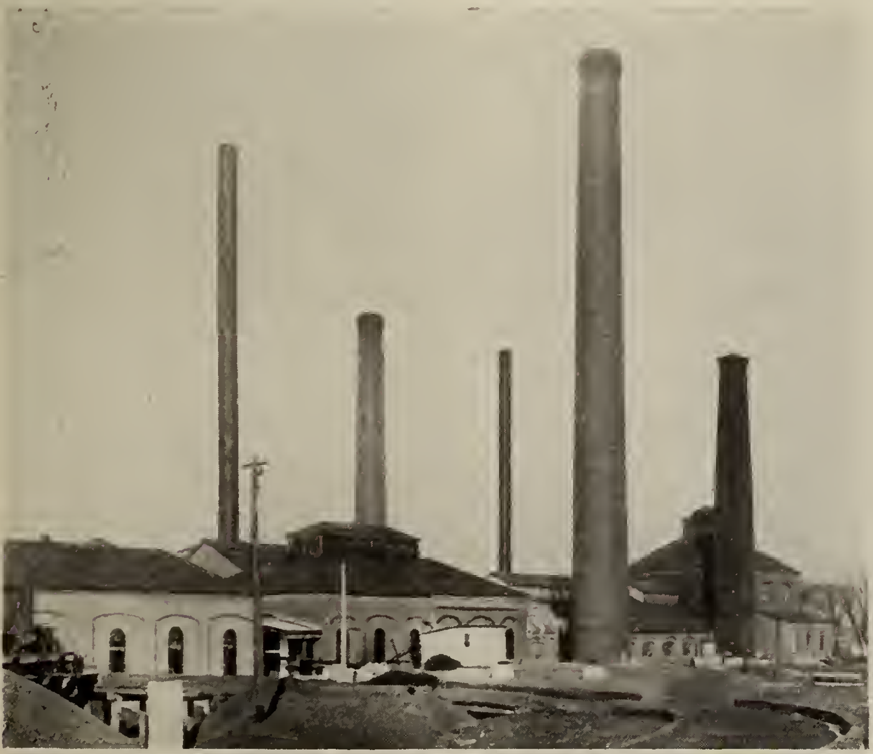

FIG. 1. LOW LEVEL PUMPING STATION, MONTREAL CITY WATER WORKS.

Looking at Fig. 1, there will be seen at the extreme right, the end of the old hydraulic plant, which is soon to be demolished to make room for the new projected hydro-electric station, when the old canal had been widened, deepened and concreted. The next building to the left contains the first auxiliary steam units, and the other buildings contain the additional equipment which to-day constitute one of the most complete and economically operated pumping plants on the continent.

Pumping Equipment

The plant from the very nature of its growth exhibits in itself a most interesting history of the development of pumping machinery during the past 50 years.

No. 1 pump, which is not shown in our illustrations is still in active service, and No. 2, which is seen in Fig. 2, is a pump furnished by the Worthington Pump Co. to supply water for general purposes at the Columbian Exhibition in 1893. This pump with a capacity of 8 million gallons per day was at that time the last word in economy and efficiency, and brought to its builders the Grand Prize in competition with the whole world.

It is most interesting to turn to Fig. 3, a photograph of a De Laval turbine driven centrifugal pump of 30,000,000 gallons capacity, which has just been installed. This unit is driven by a multi-stage De Laval steam turbine which develops 1,800 horse power when running at 3,600 revs. per min. The power from the turbine is transmitted to the pump by double helical gears which revolve the pump at 600 r.p.m. The steam turbine exhausts into a Wheeler condenser, which maintains a vacuum of 29 inches. The condensate is pumped by hot well pump through an auxiliary heater in condenser head to an open type Cochrane heater, which reheats the condensate to a temperature of 210 degrees Fahr., by means of low pressure steam taken from low pressure stage of turbine.

After leaving the heater, the water is passed through a Cochrane type V notch recording meter to the feed pump, which returns water at steam temperature to the boilers. The hot well pump is also driven by steam taken from low pressure stage of turbine.

In the background of Fig. 3 may be seen the "Columbian" pump, and the progress in pump design, during the past 30 years could not be better illustrated.

Fig. 4 illustrates the intermediate stage of pump design, being a "McDougall" centrifugal pump, direct connected to a "Browett-Lindley" high-speed triple-expansion engine, and of this type, there are four pumps in plant.

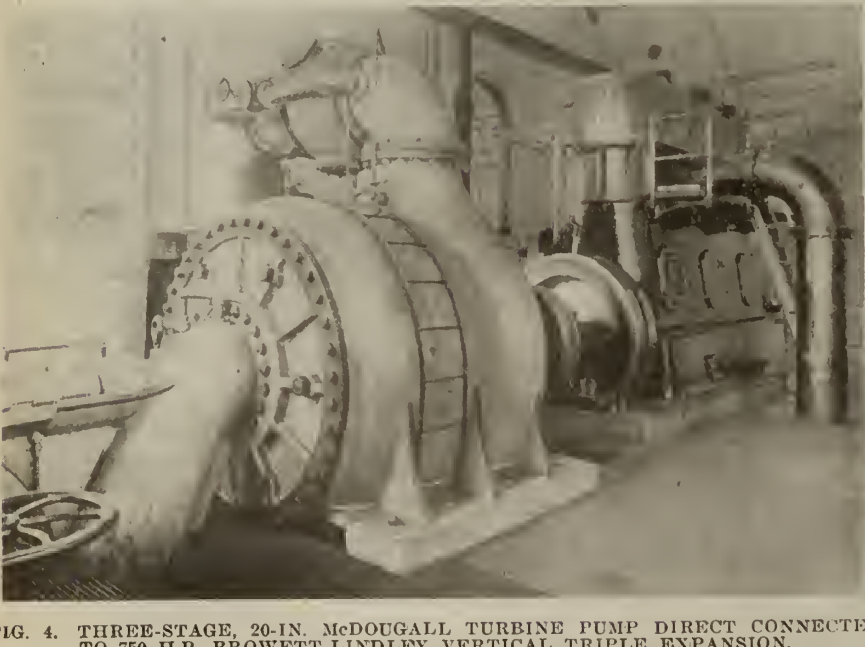

FIG. 4. THREE-STAGE, 20-IN. McDOUGALL TURBINE PUMP DIRECT CONNECTED TO 750 H.P. BROWETT-LINDLEY VERTICAL TRIPLE EXPANSION, QUICK REVOLUTION ENGINE.

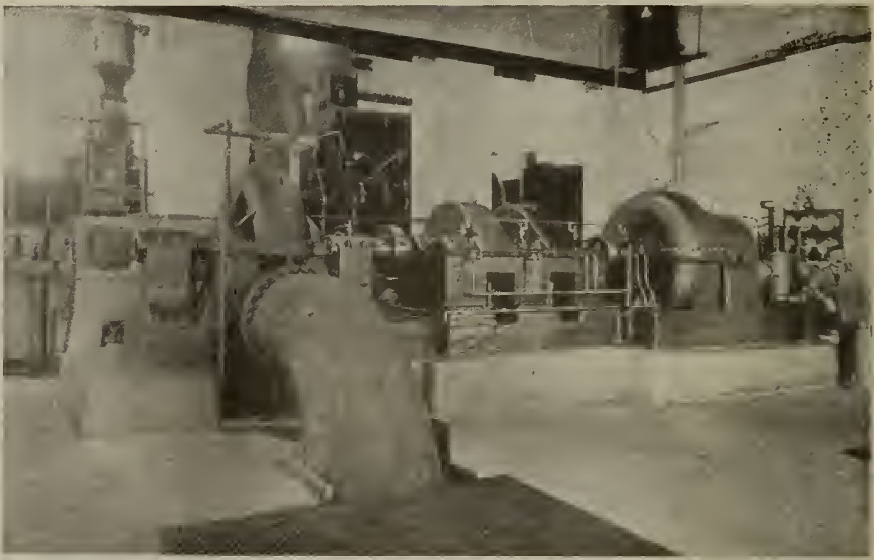

FIG. 3. SINGLE STAGE, 30-IN. DE LAVAL TURBINE PUMP DIRECT CONNECTED TO DE LAVAL MULTI-STAGE, 1800 H.P. IMPULSE STEAM TURBINE.

The total pumping capacity of the present equipment, pumping against a head of 210 feet to the lower level reservoir above McGill University is as follows.

1	Worthington	10	million gals. per 24 hours
2	Worthington (Columbian)	8	" " " " "
3	Jno. McDougall Caledonia Iron Works	12	" " " " "
4	Worthington	12	" " " " "
5	Jno. McDougall	12	" " " " "
6	Canada Foundry	12	" " " " "
7	Jno. McDougall	12	" " " " "
8	De Laval Co.	30	" " " " "
	Total capacity	108	" " " " "

Boilers

The boiler room like the pumping station shows the same evidence of expansion and modernization. The original pumps were designed to operate at 110 pounds steam pressure, and the boilers that served these pumps were operated at this pressure. With the newer pumping machinery came engines requiring higher pressures, and with the exception of six old boilers that are used for the two oldest pumps, steam pressure is carried at 150 pounds, with 100 degrees of superheat.

The principal units in operation are, 6 Heine; 3 Caldwell; 3 Robb-Mumford; 2 Howden; 1 Canada Foundry; 4 Wicks, three of the last mentioned are of vertical type and all the others are horizontal water tube boilers. The most recent equipment consists of the three vertical Wicks, 350 h.p. boilers; and last but not least is the 500 h.p. horizontal Wicks, shown in the foreground of Fig. 5, which is a view of the north side of the boiler house.

Fuel and Combustion

Bituminous coal was the fuel used for many years, but owing to smoke for which the plant was formerly somewhat notorious it was decided to use small anthracite "Bird's Eye" coal mixed with 15 per cent. bituminous slack.

Forced draught is used, with special grates, and the results have entirely justified the change. The estimated saving by using the cheaper grades of coal is about $40,000 annually, and with the exception of a few minutes, when cleaning fires, there is never more smoke than is shown in Fig. 1.

Every car of coal, when delivered at the plant, is sampled, and tested at the water department laboratory by the chemist in charge with a Per Se mechanical agitator to determine condition as to size and dust, and is also analyzed for efficiency, or the number of British Thermal Units contained per pound of coal.

Each smoke flue is connected by means of ⅛ inch brass tubing to a room behind the boiler house where gas samples can be conveniently drawn from any boiler flue and analyzed. This practice is of great value in determining the state of efficiency at which the plant is being operated.

The forced draught equipment consists of undergrate blowers. Some of the boilers are equipped with steam jet blowers and special grates supplied by the Cotton Furnace Corporation, Newark, N.J.; three units with a similar system installed by J. W. Lamoureux of Montreal, while the last 500 h.p. Wicks' unit is equipped with a Coppus Turbo Blower and special grates supplied by H. L. Peiler & Co. The Coppus blower is seen in the right-hand foreground of Fig. 5.

All the forced draught is automatically controlled by Mason No. 4 damper regulators, operating special cone-seated balanced valves, which give extremely close and accurate regulation and were furnished specially for this service by H. L. Pelier & Co.

Auxiliaries

As all the pumping engines are run condensing, there is very little exhaust steam available for heating the feed water. The only exhaust available for this purpose at atmospheric pressure is from the engine of a high-speed electric light set of 40 horse-power, also from the exhaust of the boiler feed pumps, only one of which is in operation at a time. To overcome this difficulty and utilize any available heat losses, two closed feed water heaters are connected to the exhaust line of Nos. 3 and 4 pumping engines between the engine and the condenser. The exhaust steam is under a vacuum of 28 inches at this point, but the feed water heaters absorb sufficient heat from this exhaust steam to raise the temperature of the feed water to from 90 to 100 degrees F. or practically to within 10 degrees of the temperature of the exhaust steam at the relative vacuum.

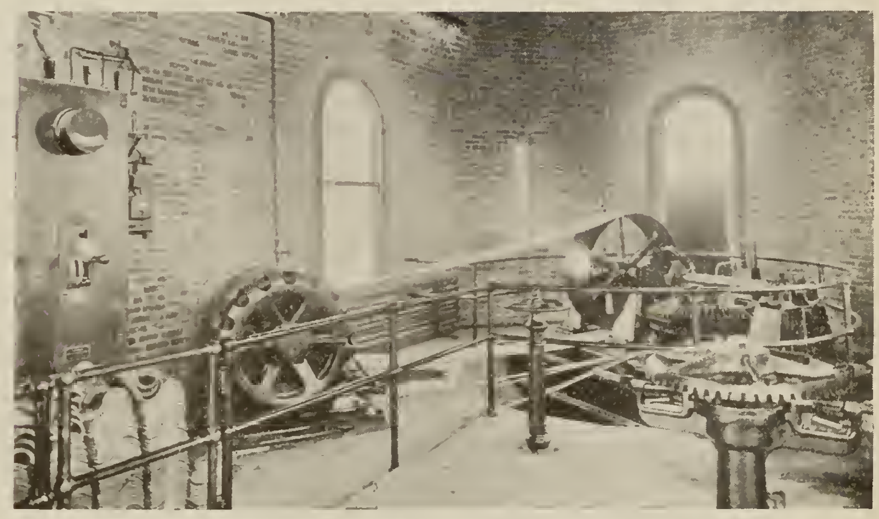

FIG. 6. LOW LIFT McDOUGALL SUBMERGED CENTRIFUGAL PUMP, BELT-DRIVEN FROM A 75 H.P. WESTINGHOUSE INDUCTION MOTOR.

The cold water from the mains is pumped through these two heaters to a third smaller unit in which all the available atmospheric exhaust is condensed, yielding a final temperature of from 160 to 190 degrees according to the load. The heaters used in this case are of the Reilly multicoil type, and were supplied by H. L. Peiler & Co.

This is said to be the only case in Canada where exhaust steam at a high vacuum is used for this purpose, and the estimated economy is about $12,000 per annum.

The two feed pumps are of the duplex type made by the Deane Pump Company of Holyoke, and were supplied by the

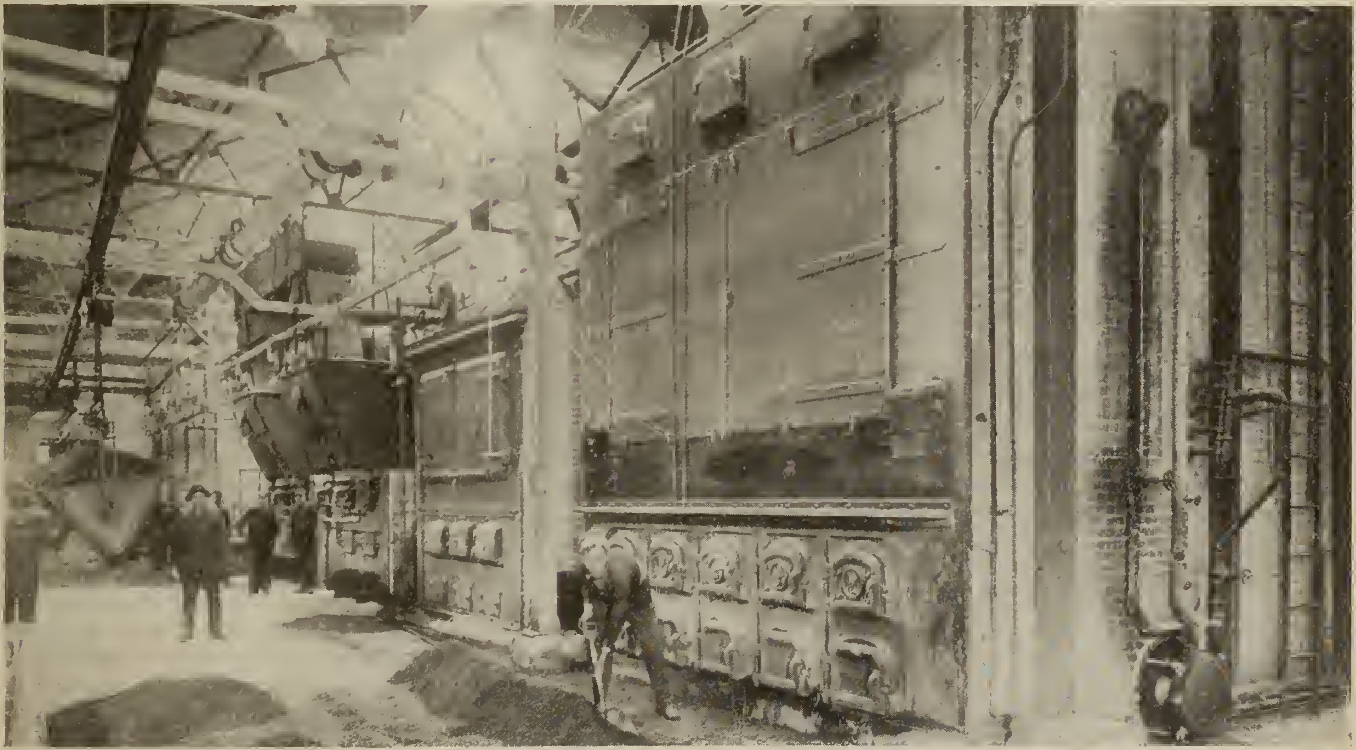

FIG. 5. NORTH SIDE OF BOILER ROOM SHOWING COAL AND ASH-HANDLING EQUIPMENT.

John McDougall, Caledonian Ironworks, Montreal, and Ross & Greig, Montreal.

All high pressure drips such as those from the steam separator, the steam mains at each end of the plant and from the steam jackets of the cylinders of Nos. 1, 2 and 4 pumps, are drained by Bundy traps discharging to a closed receiver in the boiler room from which they return automatically and under pressure through a No. 124 Bundy return trap direct to the boilers.

As No. 1 and No. 2 pumps are designed for low pressure, this is reduced from 150 lbs. to 110 lbs. by a Mason standard reducing valve.

The boilers are equipped with automatic feed control of the Berry & Williams type and the feed pumps are controlled by Mason pump pressure regulators.

Emergency Station

In case of any unforeseen accident, whereby the supply from the river should be cut off, an emergency conduit from the Lachine Canal has been installed. The fall from the canal to the plant is sufficient to supply the pumps, but it was deemed advisable to install machinery to raise the water to a height of about 6 feet.

Two similar units with a capacity of 40,000,000 gallons per day have been installed for this purpose. One of these is shown in Fig. 6. These are of the low lift submerged centrifugal type and were installed by Jno. McDougall, Caledonia Iron Works.

About six years ago, the control of the technical branch of the water works department was placed entirely in the hands of the Engineer-Superintendent, and marked changes were made in the whole operation of the plant.

The entire credit of the modernization of the pumping and boiler equipment is due to Mr. T. W. Lesage, the present superintendent, who has been ably supported by Chief Engineer E. F. Valiquet and Second Engineer J. Maconomy. It is a noteworthy case of the complete rehabilitation of a plant that was formerly a by-word for inefficiency, and which to-day ranks as one of the most efficient steam plants on the continent.

CONCERNING MANILA ROPE

By F. E. Weiss

POSSIBLY there is no article in the outfit of a railroad construction organization or of a contractor that suffers more neglect and abuse than Manila rope. In nine cases out of ten, this condition is due more to a lack of knowledge than to wilful neglect. The best rope for all purposes is made from Manila hemp, and little rope over one inch in diameter is made from anything else.

Purity Test

A test for ascertaining the purity of Manila hemp rope consists in forming balls of loose fiber from the ropes to be tested and burning them completely to ashes; pure Manila burns to a dull grayish-black ash; sisal leaves a whitish-gray ash; a combination of Manila and sisal yields a mixed ash resembling the beard of a man turning from black to gray. Manila hemp is frequently adulterated with New Zealand flax and Russian hemp, both of which are much inferior in strength.

It is not always true that the highest priced material is the best, and there are no doubt many cases where from lack of knowledge or time for investigation, a better grade of material is purchased and used than is necessary. The price of this material is governed largely by its quality, but the selection of the quality should be governed by its suitability to the work in hand.

Ropes in Service

Ropes in service deteriorate in two ways. There is the wear on the outer surface that can readily be seen, and the stretching, bending, crushing and breaking of the inner fibers that cannot be discovered without a careful examination. Should these conditions develop more rapidly than the service in which the rope is used seems to warrant, they may be due to the following causes:

The first may be caused by chafing, resulting from ropes rubbing against each other or dragging across hard materials, or by running over sheaves having too small a groove. The latter may be due to overload or to running over sheaves or pulleys of much too small diameter. Ropes do not give out all at once, and therefore need much care and attention.

Manila hemp is a vegetable fibre and is susceptible to the action of water and air the same as an unprotected piece of wood. In fact, the hardest wear on a rope is exposure to all kinds of weather. This cannot be avoided in construction work; therefore, when a rope has become wet and muddy, it should be cleaned, dried and stored in a well ventilated place. Wet rope placed in a box or unventilated storeroom is likely to rot or ferment and will become worthless in a very short time. Ropes that must necessarily be constantly exposed to the weather are tarred frequently, but as the tar affects the tensile strength, it cannot be used on ropes that are subject to hard use on derricks and cranes. Tarred ropes may be used for guy lines, the rigging of ships or similar work.

It is generally conceded that moisture will not injure a rope in storage, provided the storeroom is well ventilated, and in fact some dealers advocate a damp storeroom. On the other hand, a rope may become seriously injured by becoming too dry, because the fibres become brittle. A rope should not be allowed to freeze after becoming very wet, or if frozen, should not be used, because the frozen fibres will break and thus make it useless. Neither should rope be piled against radiators or steam pipes for obvious reasons.

Rope Failures From Overloading

The failure of ropes is more likely to be due to overloading than to any other cause. Should a rope be subjected to an overload, it may be shown by the twist coming out of it, or by one of the strands slipping out of its proper place. In the handling of heavy loads with a derrick or crane, the load should never be applied suddenly or with a jerk, not only because the stress will be many times that of the weight to be lifted, but it will cause deformations in the rope that start deterioration.

Should there be a kink in the rope, the damage may be serious enough to cause failure, and in any event the rope will have lost a good deal of its strength and value. Ropes used on derrick cranes and pile drivers wear out very rapidly. It is said that a rope 1½ inches in diameter will wear out in handling from 7,000 to 10,000 tons of coal, while a transmission rope of the same size, running 5,000 feet per minute and carrying 1,000 horse-power over sheaves 5 feet and 17 feet in diameter, will last for years.

Small Sheave Effects

The rapid wear of ropes used on derricks and pile drivers is due to their passing over comparatively small sheaves under load. When passing over a small sheave, the rope is subject to sharp bending, which causes the fibers to slide lightly on each other, and, as they are somewhat rough, the friction ultimately causes the fibers to break. Frequently upon opening up ropes of this kind, it is found that some of the inner fibers have been ground to a fine powder.

Manufacturers aim to overcome this difficulty by treating the fibers with tallow or graphite, or both, but there seems to be considerable difference of opinion as to the value of such treatment. Tallow-laid rope is not affected as much by weather conditions as rope not so treated. Should it be necessary for a rope to run over two sheaves, bending first in one direction and then in another, the difficulty last described is much exaggerated, and is much like bending a pliable wire first one way and then the other. It will soon break.—From an article in the Railway Age Gazette.

Power Transmission Section

THE MANUFACTURE OF LEATHER BELTING—II.*

By F. H. Small.**

IN our previous article on the manufacture of leather belting, it was stated, that if the belt maker always knew what qualities he wanted in the leather from which he made his belting, he could go far toward obtaining these by proper choice and application of tanning material. We enumerate these qualities as our experience has shown them:

Belting Qualities Desired

First—We need good driving surface, sufficient friction between belt and pulley to eliminate slippage as completely as may be, and to enable the belt to carry its load under minimum tension, thus avoiding useless waste of power at the bearings.

Second—Lateral stiffness, coupled with pliability, the stiffness to keep the belt from twisting and waving and to prevent its curling at the edges when shifted; the pliability to enable it to hug the pulley, wrapping itself round and so securing large arc of contact, and to enable it to alter its shape with the minimum of internal resistance as it travels round the pulley.

Third—Good tensile strength that it may carry its load without breaking.

Fourth—Little stretch, but considerable elasticity; the former so that it will need to be shortened as seldom as may be, i.e., will do its work uninterruptedly; the latter so that it may easily take up and let go its load as it travels round the pulley.

Fifth—Firmness or stability, much the same as lateral stiffness, so that the leather springs little when cut, holds its shape, remains straight and runs true on the pulleys.

Sixth—Resistance to external conditions, such as heat, moisture, chemicals, etc.; that it may do its work in any place, at any time, and enduringly.

Seventh—Low initial cost.

It is apparent that no leather can have all these qualities in the highest degree, for some of them are incompatible. Sole leather would do admirably as far as lateral stiffness, little stretch, and firmness are concerned, but would fail lamentably to satisfy the requirements of pliability, tensile strength, elasticity, etc. The best result we can achieve is bound to be somewhat of a compromise. We must aim to get the largest measure possible of the most desirable qualities in our leather, with the least necessary sacrifice of others. There is where the beltmaker who tans his own leather has a marked advantage in that he may bend all his efforts to so adjusting his tannage as to secure the best possible compromise. Quality belting demands then—first, suitable hides; second, suitable tannage.

Belting Leather Preparation

We now have the leather and may proceed to prepare it for making into belting. Of the hides which we have tanned only 50 per cent. may legitimately be cut up into belting and less than 40 per cent. will go into first quality belting. First, we reject the bellies, cropping or cutting them off at the flank; this loses us 25 per cent. of the hide. Next we cut off the shoulder at a point 4 ft. 4 in. from the tail, or, if the hide be exceptionally small, at a less distance; this loses us 25 per cent. more, leaving us for cutting into belting a "bend" which constitutes less than 50 per cent. of the original hide.

This bend has now to be curried, i.e., given a supplementary grease-tannage; set out—to give a smooth flat piece of leather — and then stretched. The stretching is done on frames in which the wet leather may be clamped and subjected to so much tension as desired, the leather being allowed to dry under tension on the frames so that an additional stretch resultant upon the natural shrinkage of the leather in drying is imparted to the leather. Before being stretched the bend is usually cut into a centre and two side pieces, inasmuch as the centre portion being more close fibred will not stretch as much as the side pieces and by being divided as above the leather can be stretched more in accordance with its capacity. After stretching, the leather is rolled and glassed to improve its appearance, and is then ready to go to the stock room.

When the leather is received in the stock room, it is sorted according to weight or thickness—which in this connection are practically synonymous terms—into extra heavy, heavy, medium and light, and then packed down for future use. The sides are packed in square piles, alternate layers at right angles, to keep the stock flat and straight and allow of a circulation of air through the pile, thus aiding and hastening the seasoning process. This seasoning is an often neglected, but most desirable operation, for the use of well-seasoned leather is as important in the manufacture of belting as the use of well-seasoned lumber is in building. Belts made from well-seasoned stock stretch less and more uniformly, retain their elasticity and wear longer than belts from green stock.

Producing the Belt

From the stock room the leather goes to the belt shop, where its manufacture into belt takes place. The first step in this process is to straighten one edge of the leather. Next it is cut into strips of various widths by passing between a rapidly-revolving circular knife and a guide, the strips being graded for width and roughly for quality as they come from the knife, and then stored in racks. From these racks the leather goes to the sorters, by whom it is most carefully graded, both for thickness and quality, and on their expertness depends the maintenance of the standard set for each brand of belt. Accurate judgment of quality depends on wide experience in handling leather and a good all-round knowledge of the specific characteristics of the leather in different parts of the hide, for it is a fact that no two square inches of hide are precisely alike.

Quality, however, is very elusive of definition when one tries to imprison it in the confines of a specification, and the buyer is fully as likely to be well served if he states his needs and trusts to the honesty of an established and reputable house as if he attempts to be his own judge. The author has in mind a large railroad buying belting according to a specification which called for the leather to be cut from strictly first quality belting butts, and they were getting it, necks and all. Inasmuch as a belt is no better than the poorest strip in it, similar to the chain that is no stronger than its weakest link, it may be imagined how well they were being served. Later when the author's company had an opportunity to supply this railroad with some belting, we were rather chagrined to have it rejected by the railroad inspector. Some rolls of stock belt of a grade distinctly inferior to that first offered were then submitted and accepted by the inspector with a cheerful response: "That's what we want; why didn't you give us that at first?" For our own ultimate good we have been trying to educate that railroad on this subject of quality in belting.

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*Presented at the annual meeting of the Providence Association of Mechanical Engineers (A.S.M.E. Affiliation), September 22, 1915.

**Chemist, The Graton & Knight Mfg. Co., Worcester, Mass.

Matching the Strips

Returning to the process of manufacture, after the strips have been sorted, they then go to the fitters to be matched and have the laps marked. Pieces cut from the right side of the hide are matched with pieces cut from the left side, because all strips which are not backbone centre pieces will stretch in a curve if subjected to a sufficient strain. Narrow strips from a properly stretched side, merely as a result of the stripping, contract to a slight curve. Belts made by joining alternately rights and lefts will roll out in a curve on the floor, but will run true upon the pulleys, while belts in the construction of which no attention is paid to the matching of rights and lefts will roll out straight on the floor, but will invariably stretch crooked if subjected to sufficient tension on the pulleys. Not all belts show these characteristics noticeably, because not all belts are required to transmit sufficient load to develop them early enough in the life of the belt for them to attract attention.

The laps are marked according to the thickness of the stock and usually range between 4 in. and 10 in. in length. Laps must be longer on the shoulder end of the piece because hides become thinner, taper off faster, near the shoulder than near the rump, and longer laps are needed, therefore, to maintain a uniform thickness of belt. Shoulder ends are joined to shoulder ends and butt to butt, because the length of the laps match better, the thickness is more uniform, the stock is similar in quality and the component parts will, therefore, wear and stretch more uniformly. The laps are next scarfed and prepared for cementing.

Cementing the Laps

The usual cement employed to stick the laps has for its basis animal glue. Each manufacturer is likely to have his own pet formula calling for certain additions to the glue solution and particular methods of compounding, but they all look much alike. By this it is not meant to disparage the cement, for a cement that will hold as long as the leather will wear is a necessary component of a quality belt. About twelve years ago saw the beginnings of the now indispensable waterproof cement. Laps stuck with this are absolutely unaffected by water, either cold or hot. Whatever cement is used the process of sticking is the same in its essentials. The surfaces of the leather to be joined are coated with the cement, put together in their final position, placed between the plates of an hydraulic press and subjected to heavy pressure. From the presses the belt goes to the inspector and then to stock.

The above description applies more particularly to single belting, but the processes are much the same if double or three-ply belting is to be made. A liberal quantity of stock which has been scarfed and the flesh side of which has been cleaned up with a scraper to remove grease, loose flesh, etc. (this being the side which is cemented), is placed upon the fitter's bench. He matches these together on a smooth surface against wooden blocks, which are his standard of thickness.the pieces being matched to secure as uniform thickness as possible, and so that the laps of one ply come about half-way between the laps of the opposite ply.

Belt Adaptation to Operating Conditions

I wish to emphasize the fact that the idea that a belt is a belt and one need merely cut off a piece of the requisite length and put it on the pulleys is no longer tenable. Proper mechanical conditions and adaptation of belt to drive are just as essential to economy of operation as is the suiting of a motor to the work it has to do.

Returning to the railroad, their theory of operation was to keep rolls of belt in stock and cut off a length as it was needed. On one machine of which they had record, the average life of a belt was six weeks. Our belt man succeeded in securing the installation of a belt suited to the drive, and at last accounts this belt had been in operation over six months and was apparently then in perfect condition.

Another illustration of suiting the belt to the drive: A customer complained that an 18-in. edger belt furnished him was not working satisfactorily, and one of our belt men, investigating the conditions, found that at the high speed at which the belt travelled, the load was not sufficient to keep the belt down on the pulleys, the edges raising. The belt was narrowed two inches to 16 in., and did the work perfectly. An opposite case was that of a 6 in. light double belt on a high-speed drive, long centres, power off and on frequently. The belt jumped so badly it could not be used. A heavy double was substituted and the trouble ceased at once.

The weave room in a cotton mill was belted with medium weight first quality belts and the plant was not a paying proposition. A study of conditions convinced our belt engineer that they were using too light a belt and the belts were replaced with heavier first quality belts, and the plant was able to pay dividends.

Another similar illustration: Our salesman recommended a light double belt for a mill drive, the master mechanic of the mill insisting on a heavy single. There were several similar drives, so one of each was installed. The record of the belts was that the double was taken up and shortened 2 in. five days after installation, and not touched again when this record was completed, while the single was shortened 2 in. the day installed, 2½ in. two days later, 4 in. three days after this, 3 in. more sixteen days later, 3 in. more forty-six days later, and 5 in. again after twenty-nine days more, when it was practically worn out.

A CONVENIENT GEAR FORMULA

By H. R. S.

AS a reader of your instructive magazine, and one who takes a special interest in the section reserved for the answering of questions I would like to draw your attention to a formula which I find very useful and would no doubt be of interest to readers of the paper.

The formulae would be of especial value to draftsmen as all dimensions are shown on the blue print. The formulae I refer to is used in the cutting of spur gears. It is very simply applied and could be used very readily.

In finding the diameter of a spur gear if the number of teeth and the pitch are known the rule of adding two (2) to the number of teeth and the sum divided by the pitch will give the required diameter to be turned on the lathe. Thus the diameter equals the number of teeth in the gear, plus two, divided by the pitch. And by reversing the formulae we can find the number of teeth if the diameter and pitch are given, similarly the pitch can be found by substituting the known values in the formulae.

Thus if:

T = the number of teeth.
D = the diameter.
P = the pitch of the finished gear.

We can write the formulae as follows and substitute the knowns and eliminate finding the required dimension:

$$\text{(i)}\quad D = \frac{T+2}{P}. \qquad \text{(ii)}\quad T = DP - 2.$$

$$\text{(iii)}\qquad P = \frac{T+2}{D}$$

Trusting that the above may be of use to your valuable paper, and wishing you continued success.

Electricity and Hydraulics

WATER POWERS OF THE MARITIME PROVINCES

THE Maritime Provinces, including New Brunswick, Nova Scotia and Prince Edward Island, have a total area of 51,512 square miles, and a total population of about 975,000. Their area is relatively small and they are so much cut up by bays and arms of the sea that, with one or two exceptions, no large river systems exist. Prince Edward Island besides, is for the most part not far above sea level, and such rivers as do exist are tidal for a considerable distance from their mouths, and have little fall in their upper reaches. This tidal effect is found in all the large rivers of the whole district, so it is not to be expected that large water powers would be available.

However, possible sites are well distributed, and the handicap of comparatively small drainage areas is largely overcome by heavy rainfall and excellent storage facilities in many cases, particularly in Nova Scotia. The annual rainfall in New Brunswick ranges from 35 to 47 inches, while in Halifax the average precipitations for 35 years is over 57 inches.

There are several large power sites, comparable in size to other water powers throughout Canada, notably at Grand Falls, on the St. John River, as also on the Mersey, Gasperaux and East rivers, in Nova Scotia. An added feature in connection with these sites is that they are at or near navigable water. Grand Falls is at the head of navigation on the St. John River, while the other sites mentioned are close to excellent ocean harbors, such as at Liverpool, Sheet Harbor and Minas Basin.

Agriculture, the basic industry of all civilization, and the chief asset of this maritime country merits the best study and attention that can be given to it. With special reference to Nova Scotia, it is well to speculate on the transformation that might be worked in such already far-famed districts as the Annapolis and Cornwallis valleys, by flooding them with cheap light and power.

Existing developments are mainly of two types: first, those based on the timber resources of the country, such as saw mills, pulp and paper mills; second, those developed and used by small municipalities for local lighting and small motor loads. The largest water power plants are used for the manufacturing of pulp and paper. The development of small powers for local municipalities is also a promising field, while in some cases, larger powers near the sea coast offer exceptional opportunities for industrial activity.

Water Powers Already Developed

It is estimated that in New Brunswick there has been developed to date about 13,000 horse-power. Of this amount 56 per cent. consists of small saw mills, grist mills and pulp mills, while the balance is made up of small electric plants from 100 to 500 horse-power capacity, and one plant with 3,800 horse-power installed. This plant, one of the largest single electrical developments in the province, is located on the Aroostook River at Aroostook Falls, but the greater part of the output is used across the border in the State of Maine.

DAM ON LEQUILLE RIVER, NOVA SCOTIA, FOR ANNAPOLIS ELECTRIC LIGHT PLANT.

In Nova Scotia about 21,000 horse-power has been developed. Of this amount, 12,650 horse-power is used in the manufacture of pulp and paper, 2,700 horse-power consists of small electric light developments, 350 horse-power is used for gold mining purposes at Isaac Harbor, and the balance is made up of numerous saw mills and grist mills. Two comparatively large pulp and paper mills are situated on the Mersey River, the upper one having a capacity of 3,000 horse-power, and the lower one 1,500 horse-power. On the Sissibon River, at Weymouth, there is a pulp mill with 2,000 horse-power installed, while other similar developments exist on the Lahave, Midway, Clyde and St. Croix Rivers.

So far as Prince Edward Island goes, nearly every stream has one or more small water power developments ranging from 5 to 50 horse-power. It is estimated that 500 horse-power is developed on the Island.

Undeveloped Water Powers

One of the chief assets of the Maritime Provinces in undeveloped water powers lies in the large number of small sites available for domestic use or for small municipalities.

There are, however, two outstanding power sites in New Brunswick, Grand

Falls on the St. John River, and Grand Falls on the Nipisguit River.

The St. John River drains by far the largest basin of any river in the Maritime Provinces. The total area of this basin is 26,000 square miles, of which about 5,000 are within the State of Maine. Grand Falls is about 200 miles from the City of St. John, and a scheme has been outlined for the installation of 80,000 horse-power under a head of 140 feet. The Pokiok site, which is much nearer St. John, is said to have 30,000 horse-power available.

The Nepisguit River, at a point 20 miles from the town of Bathurst, has upwards of 10.000 horse-power available with a head of 125 feet.

In Nova Scotia, three possible sources of comparatively large amounts have been considered, and construction on a fourth has been started. The Mersey River, commercially the most important river in the Province, has exceptional storage facilities in lakes at its headquarters. There is said to exist on it the possibility of developing upwards of 30,000 horse-power at several sites. As yet only 4.250 horse-power has been developed at three different places.

PULP MILL, MAGAGUADAVIC RIVER, N.B.

The East River and the Gaspereaux River are both well supplied with storage basins. and possess a combined possible power of 24,000 horse-power.

Work has been started on a unique scheme within twenty miles of Halifax, the output of which is intended to supply that city. This scheme, besides storage in a number of lakes, involves the entire diversion of one stream into another. and the installation of turbines acting under different heads in the same power house. The combined flow of the two rivers is again to be used in a second power house situated at tide water, on St. Mary's Bay. It is estimated that 2,160 continuous horse-power may be obtained from this plant as well as 3,210 horse-power extra for 12 hourse daily.

Further investigations are being made of the water power possibilities which make it inadvisable to make a definite estimate of the total power available. Suffice it to say that many water powers, admirably suited to the various needs of the country do exist, and any efforts put forth by those interested to find such will be amply rewarded. We are indebted to the Water Power Branch of the Department of the Interior for the accompanying data and protographs.

* * *

CONCERNING ELECTRICAL MACHINERY

THE voltage which a dynamo produces depends upon three things:—The strength of the field in which the armature rotates; the construction of the armature; the speed at which the armature rotates. The current depends upon two things:—The voltage produced, and the total resistance of the circuit.

The strength of the current which can be taken from any dynamo is limited by the heating effect of the armature wires. The temperature of the armature should not exceed 70 deg. F. over that of surrounding air. The armature has two parallel circuits through each of which half the total current would flow.

The output of a dynamo is determined by the product—volts × amperes. We may, for instance, wind an armature to get 20 amperes at 250 volts, or 10 amperes at 500 volts. The output remains the same in both cases, provided the other factors are kept constant. Generally, to increase the output of a machine, we must increase the speed. This is limited by the temperature rise and the mechanical strength of the armature. Before increasing the speed it is necessary to make certain that the conductors are so wound or secured as to prevent loosening by centrifugal force. If a machine be run at 1,000 instead of 2,000 revolutions per minute we get half the voltage, and hence only half the output.

Regulation of Dynamo Output

By means of a resistance and regulating switch the current in the field coils of a shunt dynamo can be varied, and the pressure at the dynamo terminals regulated. Shunt machines can be designed to give a practically flat "characteristic" at constant speed.

If we run a dynamo at constant speed, and measure the current in the external circuit and the voltage at the dynamo terminals, then increase the load, adjust the speed to its former value and take fresh readings, we get a series of readings which show the relation between the varying quantities of "current" and "pressure."

By plotting the volts as ordinates. and the amperes as abscissae, we get what is called the "characteristic" curve for our machine. Much information can be obtained from the "characteristic" curve of a dynamo since from it the behavior of the machine under varying conditions of load can be studied.

Commercial Efficiency Feature

One important point in connection with dynamo electric machinery is the determination of its commercial efficiency; in the case of a generator, the ratio of the useful electrical activity (external activity) to the total mechanical activity applied in driving the machine; and in the case of a motor, the ratio of the useful mechanical power obtained on the armature shaft, to the electrical power absorbed. The electrical power should be measured at the terminals of the apparatus. Mechanical power should be measured at the pulley or coupling.

The electrical power can be measured with extreme accuracy, but the accurate measurement of the mechanical power in either case presents considerable difficulty. Where the dynamo is directly coupled to a steam set, the power indicated in the engine cylinders, less the portion wasted in the engine itself, gives the brake horse power supplied to the dynamo. The results obtained from this calculation cannot be regarded as very accurate, owing to the uncertainty of obtaining the exact waste in the prime mover. A transmission dynamometer, or a friction brake, is generally used to determine the horse power expended or obtained.

To determine the electrical power take the potential difference at the terminals of the external circuit, and the current flowing through a motor with the potential difference at its terminals; the product of the two quantities in either case gives the power in watts.

The efficiency could also be obtained by adding the sum of all the individual losses to the output to derive the input, or by subtracting their sum from the input to derive the output. The ratio of the useful electrical activity to the total electrical activity is known as the electrical efficiency. It should be noted that a small increase of the armature resistance would lower the figure considerably, because the armature carries such heavy currents. The electrical efficiency would, on the other hand, be increased if more turns of wire were wound on the field magnets, because the added resistance would diminish the current strength.

Efficiency of Continuous Current Machines

There are three different methods of determining the efficiency of continuous current machines.

(a)—The direct or braking method, in which both the electrical and mechanical powers are measured directly.

(b)—The indirect method. The electrical power is measured directly, then the losses are determined.

(c)—The direct electrical method. Both the energy delivered and the energy consumed are measured directly.

In a particular machine the whole electrical power developed is 21,024 watts, of which 1,024 are absorbed in maintaining the field, and in overcoming the armature resistance, the remaining 20,000 being usefully expended in the external circuit.

Hence the electrical efficiency of the dynamo is represented by the ratio

$$\frac{20{,}000}{21{,}024} \text{ or } = 95\%$$

Any direct current dynamo will run as a motor when supplied with current from some external source. The rotation of the armature is a direct consequence of the force exerted on a field by a conductor carrying current. Whenever lines of force forming part of two separately generated magnetic fields traverse a common space, there is a decided action between the two sets of lines, the tendency being to so alter their paths that as many lines as possible shall coincide in direction. To determine the direction of movement the following should be remembered:—

If in a dynamo the direction of the field flux be not altered, and if the armature be supplied with current flowing in the same direction as when the machine was operated as a dynamo, the direction of rotation will be reversed. Thus if the positive brush of a dynamo be connected to the positive terminal of the source of supply, and the negative brush be connected to the negative terminal, then the direction of the current flow in the armature will be reversed. The direction of rotation of the armature, in series wound machines, since the field flux has its direction altered, will be reversed.

In shunt wound machines, since these do not have their fields changed, the direction of rotation will be unaltered. Compound wound machines will have their direction of rotation the same, or altered, according as the effect of the shunt coils is stronger or weaker than the series. In the case of compound generators the actions of the shunt and series coils are cumulative, but when used as motors their effects are differential. Motors can also be wound so as to have cumulatively acting series coils.

When we supply an electric motor with electrical energy, its speed will increase until it reaches such a point as will produce a balance between the input of energy and the output of energy. The latter appears as useful work and as losses. Speed in a motor acts towards electrical energy like temperature in the case of heat energy. Temperature rises until the heat energy which is supplied is equal to the heat energy which is disposed by conduction, convection, and radiation. The electrical energy supplied to a motor is accounted for as follows:—

(a)—Mechanical energy received.

(b)—Friction at bearings and bushes.

(c)—Windage.

(d)—Foucault or eddy currents.

(e)—Ohmic heat energy in motor's electrical circuit.

The energy required to overcome friction, windage, and other losses increases as the speed increases. If a load be put on a motor the armature will assume some speed of rotation so that a balance between the input and output energy is maintained.

ROPE SPLICES AND SLINGS

IT is frequently necessary to splice the ends of two ropes together in order to make one long rope. Either a short splice or a long splice may be used. If properly made, the short splice will develop the full strength of the rope, but it cannot be used over a sheave because it is considerably thicker than the original rope. The long splice can be used over a sheave, but it cannot be expected to give as good service as an unspliced rope. The short splice is more quickly made.

Slings made from Manila rope for handling and hoisting heavy materials do not always receive the care and attention that they should, largely because of a lack of knowledge of what a sling will stand. Many advocate the use of new rope, and this is without doubt the safe plan. A new rope, however, is too stiff and it is better, where possible, to use parts of a rope that have been limbered up by a day's service. There are others that advocate the use of old rope for this purpose. If this is done, care should be taken to select pieces that have not been overstressed or that have not been working over sheaves. An examination can easily be made by opening up the strands, and if the inner fibers show deterioration, the rope should not be used for slings. Slings are made by splicing the two ends of a rope together, using generally what is known as the short splice.

On construction work and during wet weather, slings are subject to severe usage. When muddy, they should be thoroughly cleaned, preferably with a hose, before the mud has been allowed to dry. They should then be allowed to dry under shelter, but never in the hot sun. When slings are sent to the tool car or toolroom for storage, they should be inspected carefully and such as are not fit for continued use should be discarded. Those in good conditions should be hung on suitable pegs. Slings are frequently called for in a hurry and under such conditions there is not always time to make an examination, or it may be overlooked. It is well to be on the safe side because the failure of a sling may result in serious injury to the workman or a fall of only a few feet may damage or utterly ruin a piece of machinery.

LEGISLATION PROPOSED FOR NIAGARA POWER DEVELOPMENT

ANNOUNCEMENT was made by the Ontario Government on February 9, that at the coming session of Parliament legislation would be introduced for the purpose of developing much greater electrical energy at Niagara Falls, in accordance with the plans of the Provincial Hydro-Electric Commission.

The plans submitted to the Government by the Commission dealt in detail with a scheme that would provide the Province with a development of 250,000 horse-power with an ultimate expansion to over half a million horse-power, sufficient to take care of all the demands of expanding industries and radial consumption for many years to come. Even should an early start be made it has been estimated that power could hardly be available in much less than three years.

* * *

Medicine Hat, Alta.—The Lake of the Woods Milling Co. propose installing new equipment in the power plant at the mill here.

Modernization of Power Plant Equipment in Factories*

By W. A. Tookey, M.I.M.E., M.I.A.E.

Manufacturers of every class of commodity are gradually awakening to the fact that the source or sources of power on which they depend for the maintenance of plant capacity output are of prime importance. Developments in power generation and transmission equipment have ceased to evidence the aforetime passing interest, the latter having given place to a keen desire to become conversant with and appropriate to increased service every new achievement in the power sphere. The accompanying paper features several aspects of the latter.

In the more or less immediate future there will undoubtedly be much work for the engineering profession arising from the establishment of new industries, and also from the modernization of factories that have been in existence since a generation or so ago. Manufacturers of products that have already found a place in the world's markets will need to reorganize their factory equipment in order to maintain, if not to augment, the volume of their antibellum business in view of the keen competition that may be anticipated when the present hostilities have come to an end and export trade is once more thrown open to the countries of Central Europe. New industries may also be expected to be developed by our manufacturers in connection with goods that have hitherto been mainly, if not entirely, in the hands of Germany and Austria.

Already there has been a definite movement in this direction, but the more immediate importance of concentration upon the provision of munition and other war material has naturally affected the furtherance of such schemes. When the present period of suspense is over, the engineer will find much to do in the direction indicated, and it would seem opportune, from this point of view, to invite consideration and discussion of some of the various problems that will then present themselves for solution.

Layout of a New Factory

In the layout of a new factory it is a comparatively simple matter to plan the most suitable arrangement of machines, to design a building or buildings conformable to the site and suitable to the purpose of one or more processes, independent or grouped, as circumstances may decide. In a new undertaking the co-ordination of power generation and transmission, of heating, lighting, ventilating systems may be comprehensively studied, and at the same time each separate requirement can be considered, and such a decision made that shall ensure the highest all-round efficiency being eventually secured.

In the conversion of existing power, lighting, heating, and similar installations in factories already established and in daily operation, not only do the same matters have to be considered just as fully, but due regard must also be given to the relative importance of several conflicting issues.

Wastage in Existing Factories

Speaking generally, it must be admitted that in many factories a large amount of wastage goes on from day to day which prevents old-established concerns from competing effectively in the open market with the undertakings that have been started within recent years, either by ourselves or by other nationalities. This is no new discovery.

Much of the inefficiency that can be noted in old-established factories can be attributed to the purchase of unsuitable apparatus as a result of parsimony induced by the desire of proprietors to limit outlay upon tools and appliances to a minimum, but there is no need to dwell at any length upon such matters as these, as instances will occur to the minds of almost all engineers who at some time or another have been engaged in factory equipment work. A more serious cause of inefficiency in factories is the well-intentioned but unwittingly indiscriminate individual who, with no technical knowledge and but scant commercial ability, accepts or declines propositions in respect to new schemes of power production, transmission, and other subjects of paramount importance without soliciting the technical guidance of professional engineers.

For example, gas-power installations have been installed under circumstances which, although a certain reduction of working costs has resulted, could not compare with the greater all-round efficiency that might have been obtained by a proper and comprehensive use of steam. When eventually a professional engineer is called in to report upon such a factory equipment, his work is made much more difficult than it would have been had he been approached before wrong decisions had been given.

During recent years there have been many papers presented to engineering institutions upon the relative advantages and disadvantages of steam engines and internal combustion engines of various types. A convenient grouping of trades and industries for this purpose would differentiate between (a) those which demand the generation of power only; (b) those which also require the provision of a proportionately small amount of heating; and, finally (c), those that involve more heating than power generation.

In the first group, clothing factories, wood-working and saw mills, jobbing printers, cement works, engineering shops, grinding plants, stone-working, and other industries would be included. In the second would be comprised newspaper printing, bookbinding, cardboard box making, tanneries, laundries, and similar undertakings. In the third. chemical works, distilleries, soap works, breweries, linoleum factories, and other premises wherein a comparatively small amount of machinery, but a large number of heating units have to be served, would be indicated.

Each of these three main groups are capable of being sub-divided—first, according to the aggregate capacity of the undertaking, and second, according to the intermittency or otherwise of the demand. A third sub-division would take into account the locality of the factory.

Ideal Conditions

In order to fix ideas, it would be advisable at the outset to postulate what might be considered the ideal conditions from the point of view of maximum efficiency. These would include continuous working over long periods and the utilization of various products resulting from coal carbonization which are entirely destroyed in the usual practice of steam and gas generation. This, however, implies that the plant shall be of such capacity that the cost of recovery of otherwise waste products would be commercially worth while; involves a reasonably high load factor, and the distribution of power so produced either in the form of gas or electricity; and thereby further assumes that the plant shall be placed in a locality such that transmission can be efficiently provided for, and the entire output sold at remunerative prices.

It is obvious that such conditions as these cannot be universally met with. but it is interesting to realize that in some cases the ideal has been closely approached. Thus. in the case of gas undertakings, the utmost value of the residuals of carbonization of coal is extracted, and every day sees progress being made in the many problems that are presented to the engineers specially engaged in this branch of engineering science. It is unfortunate, however, that, despite all that has yet been done, the price at which the gas thus manufactured can be distributed is such that, speaking generally, only for comparatively low power engines is its use commercially profitable.

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*From a paper read before the Junior Institution of Engineers.

Mention should be made of the activities of numerous collieries, etc., that have installed regenerative coking ovens, which recover the tar, benzol, ammonia, and other by-products of the up-to-date coke-oven plant; also of the various ironworks which are now using the oven coke for smelting in blast furnaces and utilizing the gas, hitherto wasted, that passes from the furnace for the production of power, being generally converted into electricity and transmitted throughout the locality for their own and neighboring commercial uses.

Gas and Electric Power

The competition that exists between gas and electric undertakings for the supply of motive power for factories in large cities is particularly keen, and it is, therefore, important to realize the comparative costs of each upon a truly comparable basis. In the case of an electric motor there are several outstanding advantages when compared with a gas engine; but usually the cheaper operating cost of the gas engine determines that of the two the latter is preferable for purely commercial reasons.

Probably the majority of gas engines may be considered as working at a mean load equivalent to five-eighths of the maximum, and, according to the age of the engine as indicated by the variation in compression pressure, the gas consumption will vary from about 35 to 18 cub. ft. per b.h.p. hour. If it be assumed that a compression pressure of 100 lb. applies to the larger number of engines that are at present in operation, then, for comparable figures with regard to electric motors, it might be taken that the average engine demands, say, 19 cub. ft. of 500 B.t.u. gas per b.h.p. hour. Thus, if for purposes of comparison, the average price of town gas to power consumers be taken as 40 cents per 1,000 cub. ft., the cost of generating 1 b.h.p. hour would be three-quarters of a cent.

As regards electric motors, the estimation of the rate of current consumption is a much simpler matter. According to the size, so the efficiency varies, being higher in large machines than in small. Thus, while the former will give out as power 90 per cent. of the current applied to the terminals at full load, 88 per cent. at three-quarter, 84.5 per cent. at half, and 74 per cent. at quarter load, smaller machines would yield, say, 85 per cent. at full, 84 per cent. at three-quarter, 79 per cent. at half, and 70 per cent. at quarter load.

Assuming, as in the case of the gas engine, that the normal factory load would approximate to the equivalent of five-eighths of the full-load output, about .89 unit would be consumed per b.h.p. hour, and, therefore, for similar working costs this should be procurable for the same price as 19 cub. ft. of gas, or, on the assumption of cost already made, gas at 40 cents per 1,000 cub. ft. would be equivalent to electricity at seven-eighths of a cent per unit. In other words, electric current at 2 cents per unit may be taken as being equivalent to gas at 92 cents per 1,000 cub. ft.

Notwithstanding this vast difference in favor of the small gas engine served by town gas over small electric motors, yet there are many conditions under which the latter would preferably be installed. When, however, the load upon the engine or motor is fairly regular and continuous there is so great a difference in running costs that town gas engines, in spite of the greater space required and the more constant attention needed to keep them in the best condition, offer very considerable advantages to the smaller factory owners.

First Cost Problems

As regards relative first costs, it is difficult to do more than to approximately indicate these, as so much depends upon local circumstances appertaining to the site and the amount of piping, cabling, etc., that may be required. As a rough guide it may be pointed out that, for true comparisons, the interest upon the additional capital involved in the case of gas engines should be set off in favor of the electric motor. Take a 20 h.p. machine, for example. While a motor fixed would cost about $300, a gas engine of equal output would cost nearly double, and a suction-gas engine and producer about 3½ times as much. The town-gas engine should, therefore, be debited with $30 per annum as additional standing charges to cover higher depreciation and interest, while the suction-gas plant should be debited with an additional $75 for the same reason. This is tantamount to saying that much depends upon the average or mean load that will prevail during the period of work, and whether the amount likely to be saved by the more economical plant will, in fact, result in an actual saving of money, all things considered.

Coming to the cost of operation of suction-gas engines and producers, it can be stated that from a large number of plants of this type, operated under every-day working conditions, and including all wastage due to stand-by losses and unutilizable portions of fuel supplied, about 2 lb. of anthracite are required to generate the equivalent of one electrical unit of energy.

On this basis, and referring only to fuel cost, electricity at 2 cents per unit would be equivalent to anthracite at $14 per ton. As a matter of fact, with proper debits for water consumed for steam-raising, washing, repairs and attendance, experience with plants under ordinary conditions as to mean output, etc., indicates that the average cost of generating one unit of electricity with suction-gas engines and plants does not fall far short of 1½ cents per unit when overhead charges are also taken into account, with anthracite at $8.50 per ton. In other words, while the cost of fuel is only about three-quarters of a cent per unit, the other expenses usually amount to about as much again. These are, of course, rough figures, but will probably be of some little value for comparative purposes when it is desired to know the relative costs of different forms of power supply for factory purposes.

In some factories it is a convenience, as well as being conducive to efficiency, to generate all power in the form of electric current, and to transmit this to several motors throughout various departments. Indeed, this may be considered an ideal method, as the current, being so readily measurable, the provision of a suitable number of electricity meters on separate circuits then enables a check to be kept on the power demand by different departments, and thus to determine the proper allocation of shop power costs—a matter of very considerable moment.

It is very rarely the case that separate motors can be profitably applied for directly driving individual machines on account of the high capital outlay thereby entailed. More usually group driving forms the basis of power transmission, using as little shafting and belting as circumstances will allow.

During recent years the writer has had a number of opportunities of determining the amount of power absorbed by shafting and belts in factories, and in many instances the proportion of power thus accounted for of the normal output from the engines concerned is extremely high. It cannot be doubted that one of the problems that are deserving of careful attention when undertaking the modernization of existing factories is that of securing the highest efficiency of the devices used in power transmission, which, as before noted, are as much concerned with electrical driving as with other systems.

Where Steam is Preferred

There are, of course, exceptional cases in which steam engines are preferable for particular industries to internal-combustion engines. In large woodworking and saw mills the amount of waste combustible material is sometimes so great that it pays to burn this stuff in the boiler furnace for steam generation in connection with compound condensing engines. Indeed, in one such installation with which the writer has been connected, experiments have proved that this is by far the most economical method of obtaining power and steam for industrial purposes, the coal bill being so small as to be almost negligible.

It might be said that in instances of this kind the waste material could be put to still greater service by burning it in a gas plant from which gas engines can be served. The writer's experience, however, has been that the cleaning of the gas and the management of the gas plant, together with the amount of water used, does not make at all a clear case that gas power is always the more preferable.

It will be apparent that the author is no hard-and-fast protagonist for one type of power plant. The special circumstances that apply to individual factories always require that the fullest consideration should be given before a decision in favor of one or other of the possible alternatives is come to. It is the neglect of local conditions in this respect that has too often resulted in the wrong plant being installed in various factories, and the factory owner who desires to operate his undertaking at the minimum cost in order to compete with his trade rivals should avoid being led astray in this regard.

Working Costs

It is not enough, however, for an engineer to make arrangements for low manufacturing costs to be achieved. He must also provide the necessary apparatus whereby a constant check can be kept upon the cost of working, in order that highest practicable efficiency can be maintained. The author is strongly of opinion that a works fitted with the essentials for registering the distributed amount of power, light and heat, whether automatically or otherwise, not only enables competition to be met by a truer knowledge of costs of each process of the manufactured product, and consequent more accurate determination between the manufacturing and "overhead" charges, but also materially assists in the maintenance of economical conditions of work throughout.

In this respect it must always be remembered that, paradoxical though it may seem, it is sometimes possible to sell at a loss, and by doing so ensure increased dividends. For the sake of illustration, let it be considered that a concern doing a trade of, say, $250,000 a year finds that material and labor have cost $150,000, while the general expenses of the business for management, sales, and other charges total to $100,000. By knowing within a little the real proportion of manufacturing general charges as distinct from the administrative and selling debits it can at once be noted whether, in spite of the fact that no profit had apparently been made on the total figures given, it would not be possible to lower the selling price, and thereby secure additional contracts that would increase the gross turnover by, say, 25 per cent. It could be expected that the overhead charges might be somewhat increased, but certainly not to the same extent, so that it would thus be quite possible to sell an article at a nominal loss, and yet to earn a dividend from the difference between the large increase in turnover and the smaller increase in charges.

The Industrial Outlook

Undeniably, our future depends in a large measure, and in the immediate future particularly, upon the maintenance, sustentation, and increasing activity of our manufacturing industries. To ensure this continual progress every engineer and factory owner must work unremittingly. It is commonly reported that industrial enterprises in competing countries are able to obtain advances from the bankers upon terms which, however assailable from purely financial considerations, have demonstrably assisted in the building up of highly successful ventures in the case of Germany. Over and over again it has been proved that in foreign markets Germany has obtained orders, not on account of price, nor of superiority of the manufactured article, but solely that her terms of payment have been the more convenient to the purchaser. This means that our manufacturers should be able to do the same by having increased capital at command, and in this matter any assistance that the State can render should be forthcoming.

Enactments relating to income tax assessments already permit the individual to directly benefit by personal thrift, as proved by a remission of taxation of the amount of annual premiums paid in respect of life insurance. In like manner, thrift on the part of an industrial undertaking—as evidenced by the setting aside of an annual sum to compensate for the obsolescence of plant and machinery, and the provision of new tools and appliances which ensure the life and prosperity of the concern and its maintenance as a revenue-producing factor of increasing possibilities—should be fostered and encouraged.

The moral effect induced by the advancement and the proof of claims for such allowances could well be expected to predispose the management of industrial undertakings to launch out and forge strongly ahead when suitable opportunities presented themselves. Income tax authorities require to be educated in other directions. Were income tax surveyors examined upon matters of factory equipment and broad principles of industrial enterprise when passing their qualifying examination, as they now are in "tax law," there would then, no doubt, be a ready acquiescence to the submission made by the author that in the matter of rating of factory machinery, etc., there is much need for improvement. That it is a matter of interest and importance to the factory equipment specialist there can be no doubt.

In a paper such as this it is impossible to do more than to enunciate broad principles. One must refrain from commenting upon the items of detail that have to be considered in the modernization of existing factories. Nothing has been said of the relative merits of various types of engines, pumps, and the hundred-and-one things that are comprised in the engineering lay-out as a whole. It is hoped, however, that something has been written to interest the junior engineer, and to lead him to think for himself on the commercial, industrial, and financial matters here briefly touched upon, and to stimulate him to do all in his power to apply his knowledge for the better use of the community generally, for only in that direction can true industrial progress be achieved and national commercial supremacy maintained against all envious "strafers."

SLINGING A LOAD

THE method of attaching a sling to a load should always be delegated to a reliable and experienced man, and whether one or more slings are to be used will depend not only on the weight of the load to be lifted, but also on its shape. In placing a sling on a load, care should be used to see that the load is evenly distributed on the two sides of the hoisting hook and also that the turns of the sling do not overlap, thereby throwing an excessive stress upon one part of it.

The stresses that are thrown upon slings and ropes vary a great deal with conditions, and they are often influenced to a marked degree by circumstances, which the casual observer might consider trivial and unimportant. In particular the inclination or obliquity of the sling, in those parts which lie between the supporting hook and the points at which the sling first touches the load, must be carefully considered, as it is a highly important feature in connection with safety.—From an article in the Railway Age Gazette.

REFRIGERATION DEPARTMENT

REFRIGERATION BY COLD OR COMPRESSED AIR

By W. M. McRobert.

MANY interesting and instructive articles relative to ammonia refrigeration have appeared in these columns from time to time, and it may not be out of place to give an outline of the cold or compressed air system of refrigeration. From an economical aspect this method of producing cold may not compare too favorably with the ammonia or carbonic acid systems, but, when "Safety first" is the principal consideration, its adaptability to meet this slogan cannot be questioned.

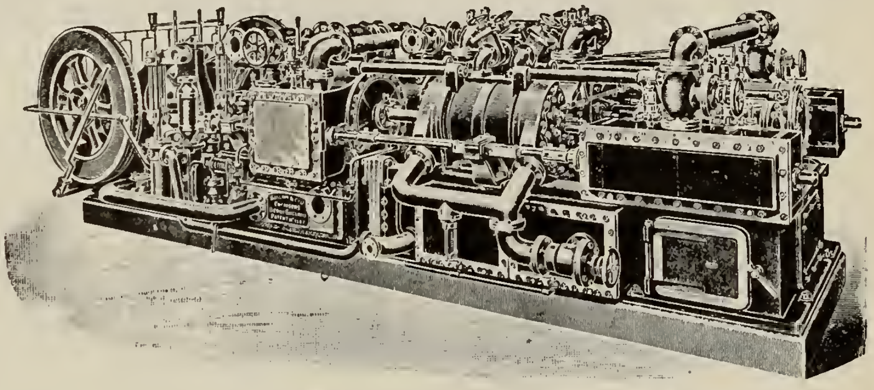


FIG. 2. HORIZONTAL DUPLEX TYPE DRY AIR MACHINE.

One advantage that can be claimed for cold air refrigeration is that there is no cost for the reagent, and that the supply is always present; also that there is an entire absence of any pungent odor. Many readers have experienced the numerous troubles associated with ammonia refrigeration, due to having too little or too much liquid in the system. This trouble is not met with in the cold air method, as the only refrigerant necessary is the atmosphere which we breathe.

The system herein described is principally employed in marine service, being extensively used in the navy, also in the large ocean liners carrying frozen meat, etc., from Australia and New Zealand to Great Britain and other parts of Europe. Many points of merit may be claimed for cold air plants, one being that apart from the compressor itself there is practically no piping to look after; also there is not the constant danger of a other methods of refrigeration.
thods of refrigeration.

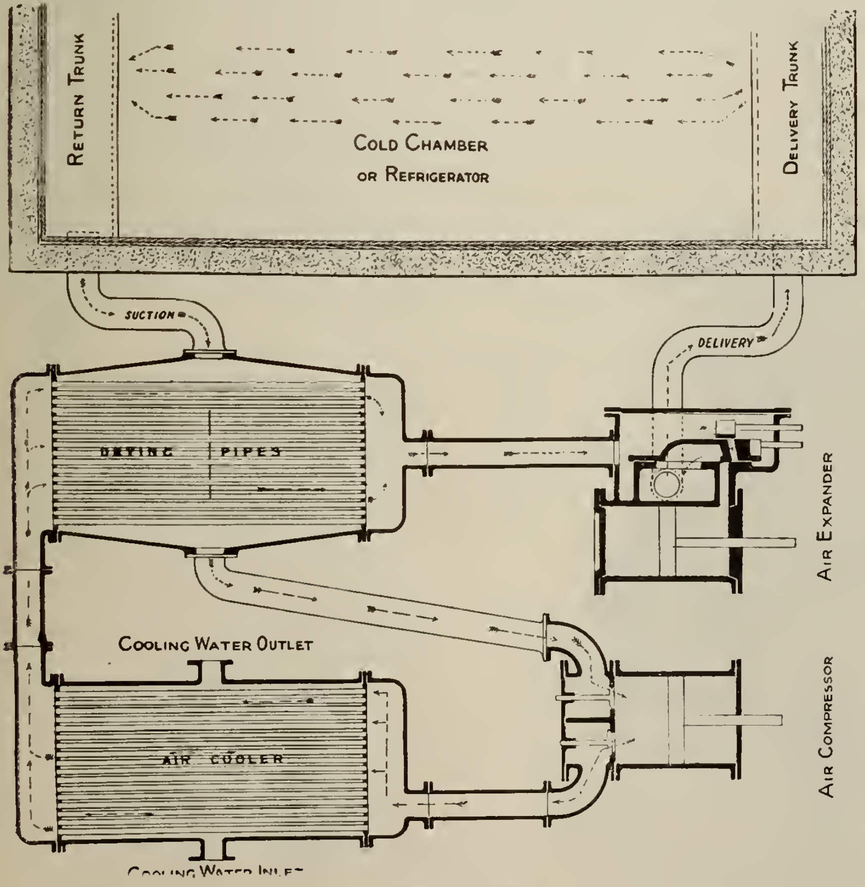


FIG. 1. DRY AIR MACHINE SHOWING HOW AIR IS CIRCULATED.

This alone is a valuable factor, as it can be readily imagined what loss of property and probably life would occur on a steamer in mid-ocean, in the event of an accident taking place with ammonia. Of course, ammonia refrigeration is also used in marine practice, but it is not generally employed where valuable and delicate cargoes have to be carried over long distances by sea. The risk is too great, consequently insurance rates are high.

The writer has in mind an instance where an entire cargo was lost, due to the head blowing off an ammonia compressor at sea. Had it not been that when the accident occurred the vessel was veered round to the wind and the entire charge of ammonia allowed to escape, probably a considerable loss of life would have taken place. This article is simply an outline of the principle employed in producing cold by compressed air.

The sketch, Fig. 1, indicated how the air is conveyed by the machine to and from the cold storage chambers. The illustration, Fig. 3, is that of a vertical dry air machine fitted with a compound surface condensing engine, while Fig. 2 is a horizontal machine of a similar type.

The steam engine by which the compressor is operated can be made either simple or compound, and be connected to one or more compression and expansion cylinders. The sketch, Fig. 1, is that in connection with a horizontal machine. Although only one cold storage chamber is shown on the drawing, that does not imply that the cold air system cannot be adapted to a number of compartments. The air is transmitted to the various chambers by means of chutes or trunks, and the required temperature maintained by means of regulating dampers fitted in the trunks, which can be opened or closed to conform with the desired conditions.

Cycle of Operation

The air is drawn from the cold storage rooms at a temperature of about 20° F., and, passing through the drying chamber on the outside of the tubes, is raised to a temperature of about 40° F. After passing through the dryer, it is drawn into the compression cylinder of the machine, and compressed to about 60 lbs. gauge pressure, which raises its temperature to over 300° F. The air is now discharged to the cooler, and passed through the tubes of that vessel, where it is reduced to a temperature corresponding to that of the cooling water.

It next passes through (not over) the tubes in the drying chamber, and by coming in indirect contact with the air returning from the refrigerating compartments is further reduced to a temperature of 40°. The air at this temperature is then drawn in to the expansion cylinder of the compressor, and is cut off by means of the slide valve at ¼ to 1-3 of the stroke. The air during the process of expansion in the cylinder is reduced to a temperature of 60° to 70° below zero, according to the ratio of expansion. While the air is being expanded it is of considerable help in the driving of the machine. The air at the above low temperature is now discharged through the snow box and along the trunks to the various chambers, and the cycle as described continued.

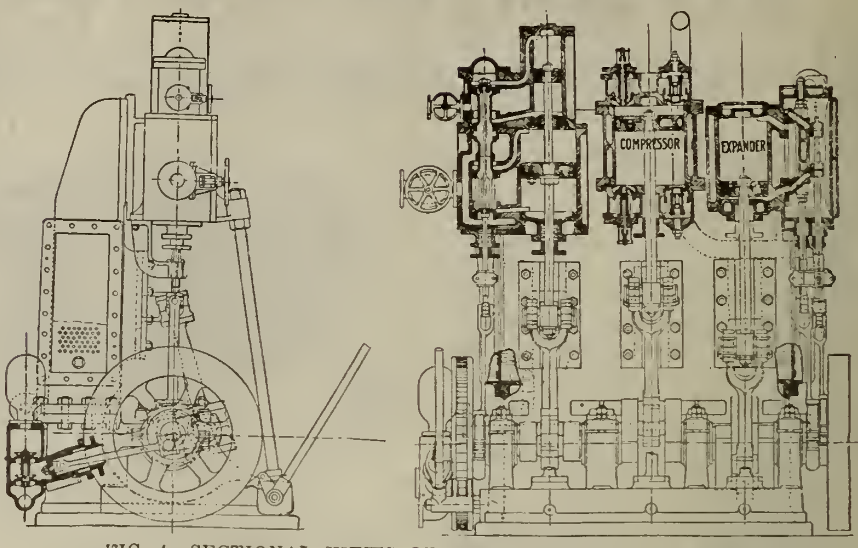


FIG. 4. SECTIONAL VIEWS OF VERTICAL DRY AIR MACHINE.

Moisture Removal From the Air

The cold air returning from the storage rooms passes on the outside of the tubes of the drying chamber at a temperature of about 20° F., while the compressed air from the cooler at a temperature of 70° F. passes through the tubes of the drying chamber, reducing its temperature to about 40°. By this means the moisture is partly condensed, and the condensation can be drained off as required, thereby keeping the air in a practically dry condition.

If the air were allowed to contain moisture to any extent it would soon collect in the expansion cylinder of the machine, thereby preventing free operation of the valves and causing scoring of the cylinder. The suction and delivery valves of the compressor are usually made of tough brass or phosphor bronze, and are kept in position by spiral springs of a similar material.

Oil is never used as a lubricant, but glycerine is employed, and is found to be excellently adapted for the purpose.

The water which is used in the air cooler is also employed on the water jacket of the air compressor and for the circulating water service of the steam surface condenser.

The complete cycle of refrigeration by compressed or cold air may be briefly summarized as follows:—The atmosphere is simply compressed, cooled, dried, and expanded by mechanical means.

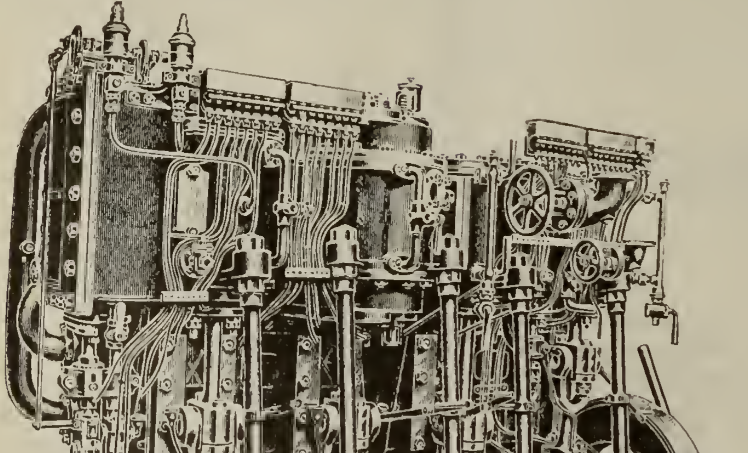


FIG. 3. VERTICAL DRY AIR MACHINE WITH COMPOUND ENGINE.

* * *

ICE PLANT LEAKS

LEAKS of ammonia are frequent, but not as common as steam. The engine and ammonia compressor should be overhauled every year, and new valves and new piston rings should be put in, if needed, to avoid leaks during the busy season, when time is so precious.

Small leaks in the brine tank are not an infrequent occurrence and often times they are not noticed until the leaks have been of long standing. For this reason the brine solution should be tested from time to time with what is known as Nessler's reagent.

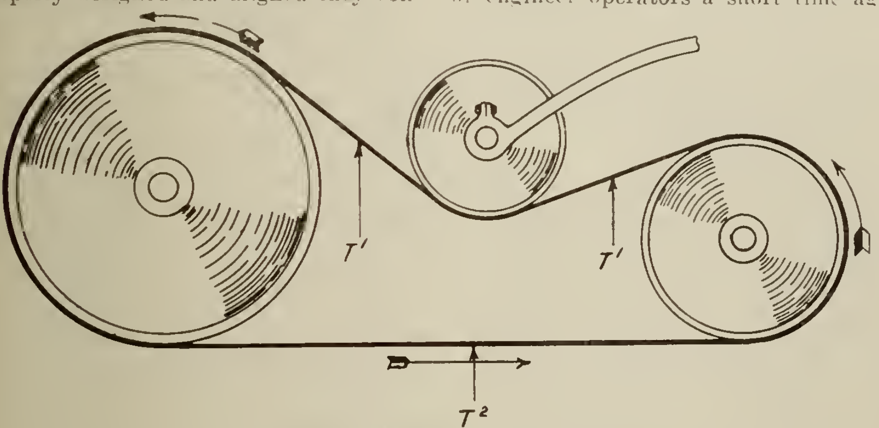
More leaks can be avoided by having the packing around the valve stems in good condition; these should be repacked every year, especially on the ammonia condenser where the pressure is highest.

The Operators' Point of View

WHY IDLERS SHOULDN'T CONSUME POWER

By N. G. Near.

MANY engineers regard an idler as "one more pulley" and as a consistent consumer of power for the same reason that pulleys consume power. This, however, is not so. Idlers consume very little energy, and when properly designed and aligned they consume so little that the loss cannot be determined with ordinary instruments.



POWER CONSUMPTION OF IDLERS.

In the sketch herewith, I indicate the reason why idlers do not consume power. On each side of the driven pulley (the "on" and the "off" side) we have different belt-tensions—T_1 and T_2. On side T_2 the belt is stretched more than on side T_1. This difference in stretch is gradually adjusted as the belt goes around the pulley; in other words, the belt "creeps" as it goes around, and the creep is in the direction of movement of the belt. The same holds true for the driving pulley except that there the creep is contrary to the direction of movement of the belt. Friction and lost power are natural results of this creep.

In the case of the idler, there is no difference in tension worth mentioning. If the idler could be made frictionless in its bearings, and if there were no windage, there would be no difference in tension at all. The only loss then would occur in the internal fibres rubbing against each other as the belt bends around the idler. All of these losses, of course, are so small that we may as well neglect them.

On the other hand, if the pulley bearings were perfectly frictionless, we would still have a power loss of about 2 per cent., due to "creep" in the belt. Therefore, even if placed on the "tight" side of a belt, an idler with a frictionless bearing would consume no power at all.

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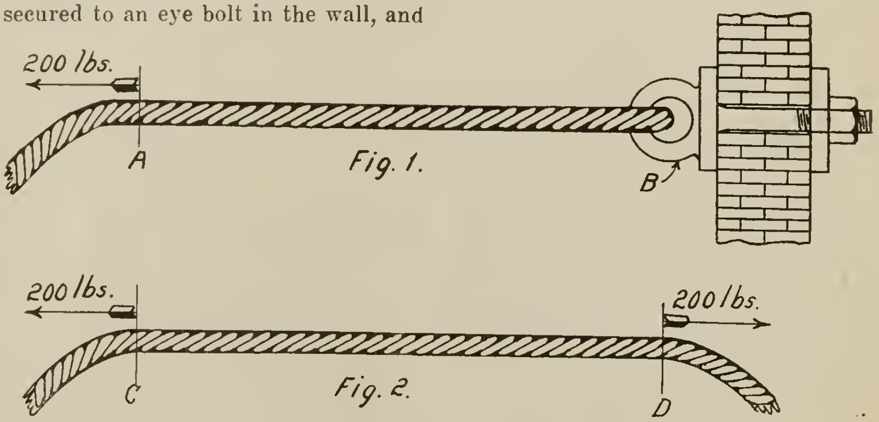
ROPE STRAIN PROBLEM

by J. R. H.

A QUESTION came up before a number of engineer operators a short time ago, which created considerable discussion. The difference of opinion was such that the writer felt that what would interest a few might also have a similar effect upon many of the readers of this journal.

The question is, what is the difference in the strain upon the two ropes shown in Fig. 1 and Fig. 2? In Fig. 1 the rope is secured to an eye bolt in the wall, and a pull of 200 lbs. in the direction of the arrows is exerted at A. In Fig. 2 a pull of 200 lbs. is acting on each end of the rope in the direction of the arrows. It was generally agreed that the strain on the top rope would be 200 lbs., but in the opinion of those interested the strain on the lower rope varied from 200 to 400 lbs. Another interesting point raised was whether the strain was equally divided between the points C and D; some contend that the strain is greater at a point midway between C and D. Any solutions from the readers of this apparently simple problem would be appreciated.



ROPE STRAW PROBLEM.

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LICENSE LAWS FOR STATIONARY ENGINEERS

By Power Operator.

I READ with considerable interest the different articles appearing in The Power House from time to time concerning license laws for stationary engineers. The more I read on the subject, the further away I get from a solution of the problem: "What is a stationary engineer?"

I know that in the engineering field there are different branches, such as fitters, turners, electricians, steamfitters, boilermakers, etc., all of which in some countries may be considered different trades, and a man is not usually asked to qualify in more than one of these branches. It appears to me that a stationary engineer must be a composition of all the foregoing, and even then he is not considered worthy of the name of engineer. I wish the Board of Agriculture would define, through the medium of The Power House, what is really meant by stationary engineer and what are his duties.

In my present occupation I have both steam and electricity to handle, and the day is not far distant when the so-called stationary engineer will not be able to get a place unless he is qualified in both steam and electric machinery. I would suggest that the name of stationary engineer be changed to power operator, and that the Board of Agriculture define the duties of that occupation.

Employers of stationary engineers usually advertise for young men, say, from 20 to 25 years of age. Now, I maintain that it is impossible for any man of that age to have practical experience in all the duties which are asked of stationary engineers.

Let us all, then, both employer and employee, be honest with ourselves, for the duties expected of stationary engineers in some places are impossible for a man to master before he is 40 years old, let alone at 20 or 25 years of age.

An Erstwhile Plumber

The other day my neighbor came to me and asked if I would come in and fix up the flash box of his w.c. I suggested that he had better get a plumber for the job. "Ah!" he said, "you being an engineer, I thought that was in your line of business." Well, I confessed that I was at a loss to say what was really considered my line of business; but, anyhow, I agreed to have a look at his trouble and see what I could do. The trouble proved to be simple, and I managed to put it right.

I give this incident as an example of what the general public expects of one who has the misfortune to be cast on the world under the name of stationary engineer. He is expected to be a man of magic. If your water pipe bursts, you will not call in the baker or the butcher to fix it; but whether it be water pipe, furnace, electric light, electric iron, stove, radiator, or the lock of the piano, the stationary engineer is expected to be able to put it right.

The Ontario License

Another subject I would like to mention here is that the present license certificate in Ontario is little credit to anyone for any person who reads up some of the numerous books on engineering for a fortnight or so can pass the examination. Let us have graded certificates, and make the examination such that the certificate granted to those who pass will be some credit to them as well as to the province. Such a certificate would inspire the young engineer to strive for the top of the ladder.

Ontario is far behind the times in this respect, and I am sure that all stationary engineers who are desirous to perfect themselves in their profession, are also desirous of obtaining a true certificate of their value. This is not too much to ask, for I am sure we all want to be equal in value to our neighbors.

In conclusion, I believe that a better system of examination for stationary engineers in this province would reduce accidents and shut-downs to a minimum and keep out impostors in addition.

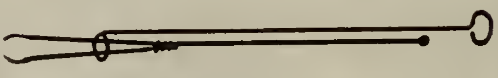
* * *

WHICH—FIVE CENTS OR FIVE DOLLARS?

By H. W. Benton

FREQUENTLY as we journey through life, we run up against something that seems to be impossible, yet, many impossible things of yesterday are accomplished, and almost forgotten to-day in the persistent race to the front. This is true of small things as well as large ones. I once read a statement on the wall of an office which is worth remembering:—"The world moves along so rapidly nowa-days, that, the man who says 'it can't be done,' is frequently interrupted by someone doing it." Let us all aim to keep clear of interruption!

Recently while one of my assistants was inspecting the water end of a duplex pump, he dropped a small wedge down throught the suction valve seat into the suction chamber. It looked like a big job to get that wedge out, for it could not be reached by the hand, or with a long pair of tongs. He made a wire hook and tried to work a slip loop over the end of the wedge, but to no avail. Later he came to me with the statement that the wedge was in the suction chamber of the pump and that the only way to get it out was to take down the suction line and reach up into the short nipple which was screwed in the pump body.



WHICH—FIVE CENTS OR FIVE DOLLARS.

To do this it would have taken some hours on account of the system of piping in connection with the pump.

The wedge was ultimately taken out by the use of the tweezers shown herewith, and without dismantling the piping. These were made of 3-32 inch copper wire; the ends being hammered flat in order to grip the wedge. The tweezers were let down through the valve seat, and placed over the wedge, then by pressing down on the loop wire, they were closed upon the wedge and the latter lifted up to the valve seat where it was easily handled. The job cost about five cents. Taking the pipe line down would cost at least $5.

CARE OF MOTORS AND GENERATORS

By C. L.

THIS subject has been written about until one would almost think nothing more could be said, yet I was particularly struck by some advice published in the December number of The Power House, entitled "Electrical Machinery Operation."

The writer started out very nicely, but it seems he has been more accustomed to old type machines with oil cups and copper brushes than those modern and up-to-date, judging by his remark, "If there is ring lubrication."

All modern machines, or those built in the past 15 years at least by up-to-date builders, are of the ring lubricating type. A few have used chains instead of rings, but these are practically the same. In all, the rings or chains are so proportioned that the oil if of proper quality, will not hinder their rotation. The rings, however, sometimes become slightly out of round by rough handling when the armature or journals are being removed for repair. This should be carefully avoided when repairs are being made.

If modern carbon or graphite brushes are used—being always found on up-to-date machines there is no necessity to raise them off the commutator when the machine is stopped, and few are built so that this can be done. The brushes, however, should be kept clean and free to move so that they will easily accommodate themselves to any slight unevenness that might be in the commutator. Serious sparking results, should the brushes or any one or two of them become stuck fast in the holders as the latter circumstance causes poor contact with the commutator bars.

The technical man is all right, but he is of little use in regulating brushes. Vibration of the machine from any cause is very bad for the commutator, and causes it to wear excessively, being acber of years spent in building and repairing barrows was necessary to make

I am surprised to note that emery cloth is recommended for use in cleaning the commutator or for grinding out flats, especially after the writer has companied with more or less sparking and frequently causing flats.

spoken of being careful about copper dust getting between the bars. Emery is a conductor of electricity and more liable than copper to stick between the commutator bars.

Therefore, the use of emery cloth should by all means be avoided, for should any of it get into the journals, which it might easily do, there will be plenty of trouble ahead. The farther emery cloth can be kept away from the machine the better. Sand paper of about No. 2 grade should be used to grind up the commutator, and if used on a nicely fitting curved block will produce a very satisfactory job. No. 1 grade should be used to make a smooth finish.

It is practically impossible to file out a flat on a commutator. A piece of an old grind stone curved out to fit does good work with no danger of causing trouble, between the bars. Should the depressions be too deep to grind out, the lathe is the only cure, and here the use of emery as recommended by the writer of the article, who is probably more technical than practical, should be strictly avoided. Fine sand paper only should be used to do the polishing after the lathe work is done.

The best way to avoid trouble with electrical machines is to put them in charge of careful and experienced engineers, and a periodical inspection by an expert will not then be necessary.

* * *

TESTING ARMATURE FAULTS

By W. H. Smith

THE bar-to-bar test is, in my opinion, the best that can be carried out by the ordinary operating engineer for detecting armature faults. Briefly, it consists of sending a current through the armature and measuring the drop across adjacent bars. Obviously, if the coils are in good shape, and connected correctly, the drop will be the same between all bars, or at least nearly so.

Referring to the diagram, a current is sent in through the armature at bar A, and out at bar K. The galvanometer is connected to a contact piece in which the contacts are so spaced as to rest on adjacent bars. To make the test, the lamp bank is adjusted so that the galvanometer gives a good readable deflection. Suppose the contact piece is on bars B and C, and a good coil X is between, correctly connected, a standard deflection will be obtained. The latter will also be obtained on each set of bars in moving toward E till bars E and F are bridged, when little or no deflection will be noted as the coil between is short circuited and its resistance lowered thereby.

Bars F and G will give a standard deflection, while bars G and H will give about twice the standard deflection as two coils are connected between. Bars H and I will give a standard deflection but in the opposite direction as the coil is crossed between. Bars I and J will give about twice the standard deflection, due to two coils being between.

In trying the other side of the commutator, we find that bars L and M give no deflection, so the circuit must be open somewhere. No deflection is obtained until we bridge bars Q and R, when a violent throw of the needle locates the open circuit between these bars. Bars P and Q, and S and T show deflection, again proving that the break is in one of the leads to bar R. If these defects are remedied, and all connections are good, about the same deflection will be obtained between all bars although it will not be the same as the previous standard on account of there now being two paths for the current around the armature where before there was only one.

A temporary remedy for an open circuit is to connect the bars that are open by a short piece of copper wire, but the break should be repaired permanently as soon as possible. A short-circuited coil (except where the turns are short-circuited on each other when temporary repairs are of no avail), may be temporarily repaired by opening the coil at its ends, binding the latter back out of the way, tapping them over, and connecting the bars as for an open circuit. However, a short-circuited coil usually burns itself out, so permanent repairs are in order. The remedy for the crossed or reverse connections is obvious.

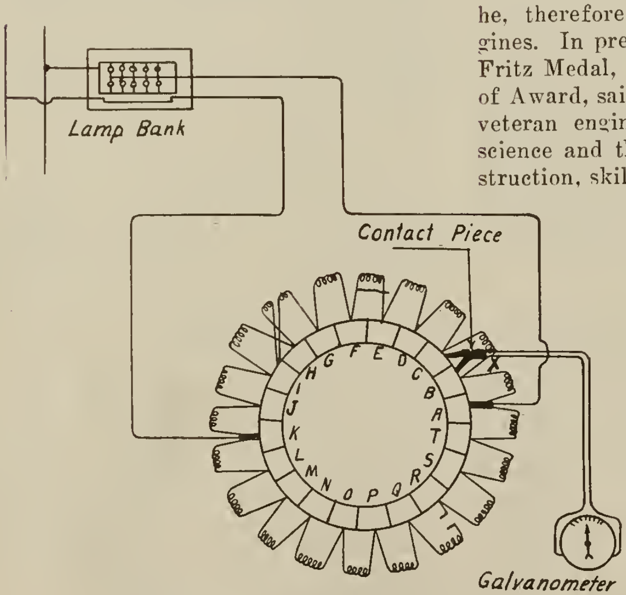
* * *

DOMINION LICENSE LAW FOR ENGINEERS

By R. McLaren.

IN the January issue of The Power House I am accused of attacking shop-experienced engineers. I think, however, almost every one will agree with me when I say that non-shop experienced engineers have been attacked whenever a shop experience clause is inserted in the engineers' license requirements.

To say that we are attacking when we are putting up a defense, is, therefore, a rather German line of talk, and will no doubt get the consideration it deserves. Instead of my letter being directed against B.O.T. engineers, it is merely a recital of my experience, and if it has had to do with B.O.T. engineers, it is not my fault; my purpose being to show that the shop experience clause does not safe-guard the employer against ignorance and incompetence.



TESTING FOR ARMATURE FAULTS.

I have not recited all of my experience. I might have told how when in the office of the manager of a plant recently, the chief engineer came in to consult that gentleman as to how to get a section out of a heater in order to repair some leaky coils. The manager's snort of contempt when the engineer left the room may not have been justified, but I can assure you, Mr. Editor, that I would rather be called a laborer any time than carry the name that engineer was called when he left the room. He was over 50 years of age, so he had plenty of time to pass the B.O.T. examinations, and get some experience besides. As he had a first-class certificate he must have had shop experience.

We are asked how a man can be an engineer without shop experience. The question sounds like an echo from the foreman who called down the operator of a wheel barrow for oiling it. He wanted to know what the devil the man knew about machinery. Apparently he was under the impression that a number of years spent in building and repairing harrows was necessary to make the man a competent harrow operator. Watt had no shop experience, yet his name is **frequently** mentioned in connection with steam engines.

While we are talking of Watt, don't you remember, Mr. Editor, how the hammer men of Edinburgh, by exercising their petty arrogance, tried to prevent him from making a living at his trade, not because he did not know his trade, but because he had not learned it in the way they had decreed that he should?

Charles T. Porter was short on shop experience, and some would argue that he, therefore knew nothing about engines. In presenting him with the John Fritz Medal, the chairman of the Board of Award, said: "Charles Talbot Porter, veteran engineer, assiduous student of science and the mechanical arts of construction, skilled expert in the design of engine details," and so on. Isn't it a pity that he had not been chloroformed before he tamed the steam engine and made it practicable for work that it never could be used for before, incidentally disproving of the musty theory that a man cannot be an engineer without shop experience. Those of you who have read his reminiscences must have noted the fact that the greatest obstacle he had to overcome was that of shop experienced men.

A few years ago an engineer applied

for a license in an eastern city, and was told that he could not have one as he didn't know anything about engines and boilers. He had no shop experience. He had begun as a locomotive fireman. Before applying for a license he had applied two eccentrics to the Corliss engine (was the first to do so), had been consulting engineer for the U.S. Rubber Co., chief engineer for the Nazareth Cement Co., and several others. The shop experience clause got him at last, however, and employers were safeguarded from such an "ignorant" and "incompetent" engineer.

Exactly on a par with the shop experience regulation is the following: — A clique of engineers in a certain city had fixed the regulations so that any one wanting a license to operate a plant in their district had to apply to them for it. A certain man applied for a license to operate a plant. He failed in his examination because the job had been allotted to the boiler inspector, a member of the clique. Things began to happen, and when the dust cleared away the applicant had his license to operate said plant "only," which happened, by the way, to be the biggest in the district controlled by the trust.

As regards a Dominion license law, I certainly approve of it. Insularity is becoming out of date, but as there are people who wish to make engineering an appendage to a trade (they can't see that engineering is bigger than any trade,) there is likely to be some opposition, and I intend to be in opposition until I know and have studied all the provisions of the law to be enacted.

◆

ANSWERS TO READERS' QUERIES

By J. M.

NOT having observed in the January number of The Power House any direct reply to the enquiries of "A Correspondent" on page 336 of your December 1915 issue, although there were a couple of excellent articles covering a portion of the ground, and, noting that many of the questions asked in trade journals and left for readers to tackle remain unanswered, I have decided to take a hand at it myself this time.

In an air compressor having only one air cylinder there is at the end of each stroke considerable compressed air remaining in the clearance, and this must expand again to atmospheric pressure before the new charge can be drawn in; therefore, except in the smaller sizes, air compressors are, for economy, compounded as are steam engines. Air is drawn into the large cylinder, being there compressed to a certain degree. It is then drawn into a smaller cylinder which compresses it to a still higher pressure. This class of compressor is called a two-stage machine. A three-stage machine has three cylinders, and a four-stage machine has four cylinders, each raising the pressure higher. Receivers are sometimes placed between the cylinders, these as well as the cylinders being water jacketed. I have never known of three or four-stage machines being used except for the higher pressures.

Special lubricators are required on the air cylinders and usually form a part of the machine outfit. If they must be procured, consult the manufacturers directory in The Power House, under the headings of lubricators and oilers. Special oil is used in these lubricators. It is thin and light colored as compared with mill oils. The oil salesmen usually patronized can probably furnish a supply of good air cylinder oil without difficulty.

Mechanically operated valves should give but little trouble if proper oil is used, yet, even with the best of oil it is good practice to use a little coal oil or soapy water on the valves at times to prevent gumming. This, however, does not necessarily mean that if the valves do give trouble it is all owing to the oil since the adjustment may not be right.

C.A.S.E. CONVENTION

The Annual Convention of the Canadian Association of Stationary Engineers will be held in Montreal, P.Q., on July 25, 26, 27.

Scale or mud in the water jacket will give more or less trouble, according to the class of cooling water used. Although 2,500 feet has been claimed as the economical velocity for air in pipes, yet 3,750 ft. per minute is permissible. A very good rule is one square inch of pipe suction to each twenty cubic feet of air passing per minute.

Bends in Pipe Lines

To find the resistance of an elbow in feet of pipe, take 19 times the square of the diameter of the pipe, and divide it by three times the sum obtained by adding the diameter of the pipe and the constant 3.6. Thus, in a 1 inch pipe an elbow has the resistance of one and a half feet of pipe; in a 2 in. pipe, 4.74 ft.; in a 3 in. pipe, 8.94 ft., and in a 4 in. pipe, 13.46 feet. Formula, $R = \frac{19\ d^2}{3\ (d+3.6)}$ where R = resistance in feet of pipe, and d = diameter of pipe. For globe valves the formula is $\frac{19\ d^2}{2\ (3.6)}$, therefore the resistance of two globe valves equals the resistance of three elbows. These formulae apply for steam, air, and gas, but may not be exact for water.

I have looked over quite a few formulae for calculating flow of water in pipes of different sizes, and at different initial and terminal pressures, and find that when worked out they vary considerably in results; but for ease of calculation I find none simpler than that given in the May, 1915, issue of The Power House in the question and answer series, if only the editor will kindly publish the table of co-efficients corresponding to that same rule and label it, so it will be easily recognized.

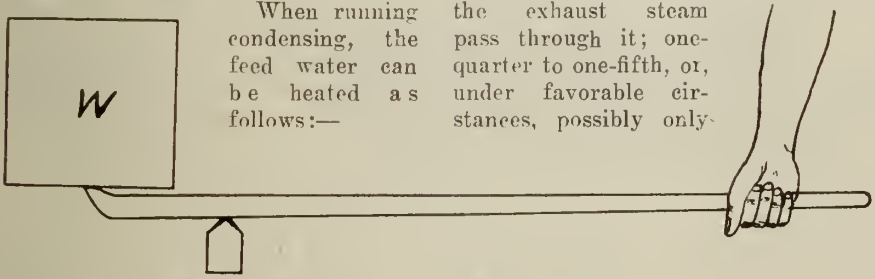
This illustrates only one of the many ways in which the well-conducted trade journal can save us time, namely, by giving us these short cuts in calculation (especially when special articles are saved for future reference by the subscribers), to say nothing of the many other ways it assists us.

Boiler Feed Problem

As for the boiler feed problem, probably "A Correspondent" desires a single injector large enough to feed the six 72 in. x 18 ft. boilers, rather than instal two of the catalogued injectors or inspirators with pipe connections, size 2½ in., of which one injector would feed three of the boilers. I believe, however, that so far as boiler feed is concerned, your correspondent is better qualified to specify than I am. I also assume that he is using or contemplates using other methods of supplying the regular feed, and requires the injector only as an auxiliary or for use in emergency. In such a case, perhaps one of the above injectors would tide over a brief delay, or two of the injectors, each serving three boilers, handle the feed indefinitely. They would be more flexible than a single injector for use in case of a partial shut-down and consequent cutting out of some of the boilers.

An injector is economical of space, is cheaply and easily installed, costs a minimum for repairs, the heat units in the steam are transmitted directly to the feed water, and there is no possibility of putting cold feed water into a hot boiler. For traction and portable outfits, and as an auxiliary in stationary plants, it has its field, and that a large one. It is not, however, a feed water purifier nor does it lend itself readily to either a combined heater and purifier, or economizer and purifier, since it will not handle hot water; besides, a heater does not give its best economy when supplied with water at 150° to 160° F., instead of, say, 60°. There is at least one class of purifier (not in the heater class) which can be advantageously used in connection with an injector. On the other hand, an injector, by using live steam to heat the feed, is not so economical as using exhaust steam or waste heat for the purpose.

F. R. Low, in his "Power" Catechism, Table VI., following question 406, places the saving of fuel with an injector feeding at 150° without heater at 1.5%; with injector feeding through heater, heating from 160° to 200°, a saving of 6.2%; with direct acting pump feeding through a heater, heating from 60° to 200°, a saving of 12.1%, and with geared pump run from engine and feeding through heater, heating from 60° to 200°, a saving of 13.2%. Each of the above are compared with a direct acting pump feeding at 60° without heater; therefore, according to those figures, when space permits the installation of a pump and heater, their use should save roughly about one ton of coal in every nine otherwise required.



SIMPLICITY—CROW BAR AND SHARP BEARING.

When running condensing, the feed water can be heated as follows:—

Heating Feed Water—Engine Condensing

1.—By placing an oil separator and a closed heater between the low pressure cylinder and the condenser, then taking the feed from the bottom of the hot well by means of a low-set pump and passing it through the heater to the boiler.

2.—Where there are a number of auxiliaries in constant operation, using an open heater and heating the feed by the exhaust of these auxiliaries, including the exhaust of the pump itself.

3.—By using an economizer heated by the flue gases and pumping the water from the hot well through the economizer to the boiler.

Plan No. 1 not only yields hot feed water, but it increases the vacuum also, thus increasing the power somewhat. Plan No. 3 can seldom be employed unless an economizer has been included in the original plan and specifications, but where carbonate of lime, sulphate of lime, or chloride of magnesia are present in the feed, an economizer may remove them more completely than a heater could, owing to the higher temperature obtainable in the economizer. The reverse is the case where carbonate of magnesia predominates, since it is more soluble in cold water than in hot.

If running non-condensing, an open heater may be used, and if desired an independent pump can be installed with its exhaust also piped into the heater. This gives feed water control independent of the operation of the engine, but, if the engine is idle, the pump exhaust will not heat the water very much. I would prefer a belted pump in connection with the heater for service while the engine is in operation, and an injector or inspirator for use at other times. To avoid cold water when starting in the morning, the pump belt could be left off until the water in the heater became hot, at which time the pump could again be started. Means should be provided for changing the speed or the stroke of the pump to suit the boiler requirements so that the pump could be left running and maintain the proper water level.

The heater should be of ample size, as the larger it is, and the slower the water passes through, the more heat it absorbs up to 210° F. as the limit. With a large enough heater, it is not necessary that all the exhaust steam pass through it; one-quarter to one-fifth, or, under favorable circumstances, possibly only one-sixth being sufficient if there is profitable use for the balance of the steam for other purposes.

Some even claim that when running condensing it would pay to divert a portion of the exhaust to the heater owing to the higher thermal efficiency of the latter—70 to 80 per cent., as compared with the thermal efficiency of even the best engines. The closed heater between the L.P. cylinder and the condenser should be more economical.

Wherever a defective globe valve or stop would necessitate a shut-down for repairs, an additional one on the same line and unused, so as not to become worn, makes repair possible in many cases without delay, as the good valve can be closed to permit of the regular one being changed or repaired, and is better than waiting for the pressure to fall.

* * *

SIMPLICITY

By W. B.

THE common crow bar, when used as a lever with a single sharp bearing, as indicated, is the simplest and most efficient machine known. The pulley and shaft, a modification of the crow bar and sharp bearing, becomes a little more complex, and a little more inefficient. With increasing complexity we, therefore, usually find increasing friction, more lost motion, greater up-keep, expense, etc. Complexity is always undesirable.

In our present state of civilization, though, we find complexity a necessity. We are continually striving for greater over-all efficiency, automatic operation, dependability and safety, and we, therefore find machines growing more and more complex.

As first made, the steam engine was rather cumbersome—complex. The idea was to make a machine that would propel itself and other machinery through the agency of heat. The cost of the energy developed was not considered as worthy of much thought. Inventors bent their principal energies toward simplifying the engine, which they did, and later on, as now, in endeavoring to get the most work possible out of a pound of coal, the mechanism of the engine has been made more and more complex until we have our present types of steam engines, turbines, gas engines, and other prime movers. Not one can be termed "simple" because they are all made up of many parts.

Every once in a while an inventor produces a change which he says "simplifies the old type," but so far as we can see there is no decided step toward simplicity. Because we are human, we all crave for simplicity in our normal lives. We like simple dress, good speech, manners and so on all the way down to machinery. For a change, one in a while, we like to dabble with complexity, but complexity is not normal. In explaining things we always aim to make the explanation and the thing explained "as simple as possible."

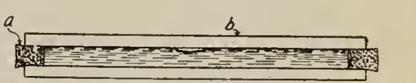
Perhaps when the millennium comes, there will be a one-piece machine with an efficiency of 100 per cent. It will be perfect in every respect, will cost little, will be strong, durable, reliable, simple.

* * *

A HANDY LEVEL

By R. F. G.

THE sketch here shown illustrates a very serviceable and convenient method



A HANDY LEVEL.

of constructing a level, and, while not very substantial, it may, with careful usage, be made to answer a very useful purpose.

A piece of gauge glass (b) of a suitable length is filled with water, and a small cork (a) inserted in each end; by adjustment of the cork any desired size air bubble may be obtained.

* * *

James English, consulting engineer of Winnipeg, Man., has been appointed manager of the Port Arthur Street Railway Co.

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ONTARIO GOVERNMENT TO MERGE ITS INDUSTRIAL DEPARTMENTS

NOTICE has been given of an interesting piece of legislation which will be brought forward at the coming session of the Ontario Parliament. It will involve the merging into one department, and under the direction of one responsible head or general superintendent, of the Labor Bureau, Factory Inspection, Steam Boiler Inspection, and Stationary Engineers' License administrations. We understand such a move has been under consideration for some considerable time past, and that the plans for giving effect to the reorganization as outlined are now fully matured. The Parliamentary head of the new establishment will be the Hon. Finlay MacDiarmid, Provincial Minister of Public Works.

The legislation proposed is such as to awaken the keenest interest in industrial circles, embracing as it does the whole wide field of provincial manufacturing and commercial enterprise. Progressiveness may perhaps be the most concise and at the same time sufficiently comprehensive phrase to employ regarding the coming development, and properly recognized as such, little difficulty will be experienced in placing the enactment on the Statute Book.

Of General Interest

Employer, employee and the public generally have a more than ordinary concern in legislation such as that proposed, and while no doubt it is possible that individual department activity and effectiveness may be in some cases most prominent in securing and producing best results, circumstances arising from administration or scope of operation may and do often indicate that results' achievement may be in still higher degree, otherwise compassed. Heterogeneous fitly expresses the existing conditions relative to the labor, factory inspection, steam boiler inspection, and stationary engineers' license departments of the Province of Ontario, and in placing all of them under the wing of the Minister of Public Works, a quite appreciable advance in the direction of greater efficiency cannot fail to be registered. All of the sections involved in the proposed merger can easily be extended in scope, usefulness and efficiency through the appointment and instrumentality of a thoroughly qualified Deputy Minister or general superintendent.

Relative to Stationary Engineers

Stationary engineers, for instance, will be no longer amenable to rules and regulations compiled to suit a Minister of Agriculture's interest in, or knowledge of such a calling, and the establishment of a system of graded certificates is, we believe, brought appreciably nearer. Unrest, in favor of discriminating between the expert fitness and intelligence—whether inborn or acquired, of engineer operators, is becoming daily more pronounced and influential, and with the new regime in control, near future action towards classification may be anticipated.

Labor Bureau and Factory Inspection

The labor and factory inspection features, about to come under central control, offer much opportunity for the display of tact, resourcefulness and co-operative effort on the part of the chief executive. Two, in great measure, opposing interests have to be dealt with, therefore such contingencies as industrial disputes, health, safety, welfare and comfort of employees, or undue interference with and imposition of superfluous burdens on employers, make imperative the attributes indicated, and give additional point and value to the impending legislation.

Boiler Inspection and Regulation

Regarding boiler inspection—or, more correctly, the drafting and enforced adoption of rules and regulations covering new and old steam boiler constructional details, examination, testing, operation, and insisted-on extermination by breaking-up when condemned as unsafe for further service, a golden opportunity presents itself for the new administrator. We have in the past been immune to an extraordinary degree from steam boiler disasters; as a matter of fact from explosions of all kinds to which vessels containing steam, air, etc., under pressures more or less high, may easily contribute. Many reasons may be adduced to explain the favorable nature of our record, but those enumerated below may be accepted as having been most instrumental in our achievement.

Boiler Safety Contributories

Our boiler builders have, in addition, been builders of reputations for the output of a first-class product, conforming throughout to proved and recognized design rules and fitness for any particular service. Our boiler attendants are for the most part men familiar with steam boiler operation and service care, it being clearly evident from such isolated explosions as have taken place, that those in attendance were absolutely unfamiliar with the work. There is nothing abnormal in this almost universal operator fitness to which we have referred, as, in the very nature of things, aspirants to positions of importance in stationary steam engineering graduate—in spite even of their previously acquired mental or practical accomplishments, from the boiler room.

Further, boilers and boiler rooms have not changed so much in the main essentials as have prime movers and the engine room section of power plants; improvement in accessory detail and arrangement being the only really marked feature of recent decades. Operators, therefore, have simply become more expert and intelligent, even in spite of themselves.

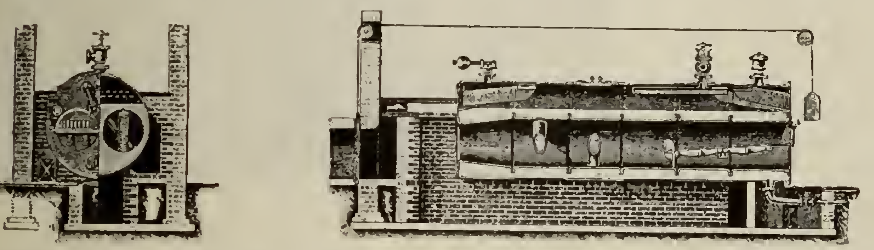
Boiler inspection as far as Government regulations have permitted, and inspection by Boiler Insurance Companies, have each made substantial contribution to the maintenance of our fair record.

We wish the new legislation in prospect all the success and results that it aims to accomplish, and these need not be in any sense problematical if the various interests concerned will but realize that it will count much in our favor industrially and commercially, and that their co-operation will be both necessary and desirable in giving it practical application.

Operators' Instruction Course

THE STEAM BOILER—II.

In passing it may be said that investigation of the efficiency of any steam generating plant need not and should not be neglected so thoroughly as to originate only through a new boiler requirement.

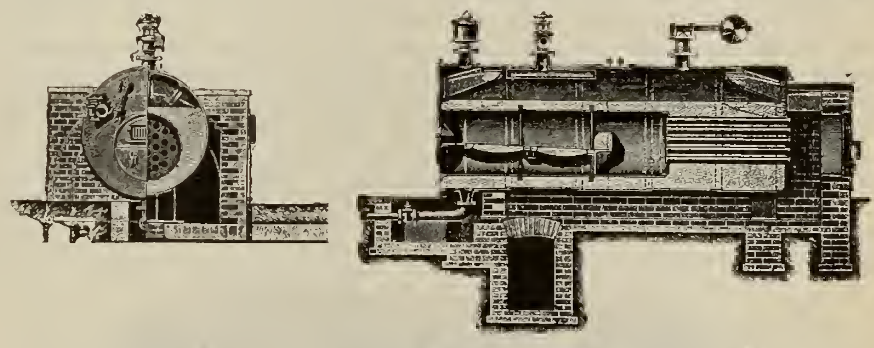


CROSS AND LONGITUDINAL SECTIONS OF "LANCASHIRE" TYPE BOILER WITH CROSS WATER TUBES.

Reference has been made to the circumstance of manufacturing plant extension necessitating increased boiler power, in which case it would follow that a steam engine or steam turbine was also being installed.

Either of these latter units might be required to conform in their design and constructional features to conditions of steam generation already existing in the plant, otherwise, the projected installation of boilers and engines would be intended to constitute a self-contained combination unit. If the former, then the data secured from the already indicated expert investigation would not only become valuable from the boiler viewpoint, but would be absolutely necessary in determining certain features of the engine or turbine unit.

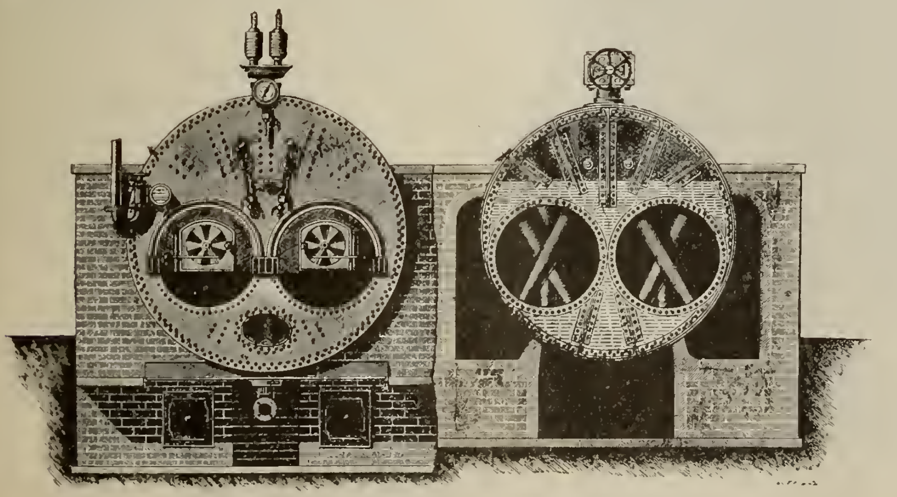
It should be understood here that we are presently dealing only with steam boilers as they relate to the engine or turbine to which they supply steam, no consideration being given to steam demand for heating or other purpose. The latter will be dealt with in detail in subsequent articles.



CROSS AND LONGITUDINAL SECTIONS OF "CORNISH" TYPE BOILER WITH SMOKE TUBES.

If the new boiler installation has for its aim the supply of steam to a new or old prime mover of known indicated horse-power, we are at once in a position to discuss and figure out the preliminaries leading up to an ultimate boiler type choice. Builders of steam engines of any type usually guarantee the steam consumption per i.h.p. of their product, and as regards the steam consumption per i.h.p. of an engine which has seen more or less service, this can easily be determined under test.

Assuming that the engine for which the steam supply is required has a rated consumption of 4,000 lbs. of water, in the form of steam, per hour, then it becomes necessary that our boiler be at least equal to this. Evaporation arises from boiler heating surface, and assuming that each square foot of the latter will evaporate four pounds of water, this will not be found very far out, we divide the engine rated consumption of 4,000 lbs. by the 4 lbs. of water, and get as a result 1,000 square feet of heating surface. Reckoning again that 8 lbs. of water can be evaporated per pound of coal from cold feed—this also is a reasonable allowance, and, dividing 4,000 by 8, we get 500 lbs., as the quantity of fuel necessary to be burnt on the grate per hour.



FRONT VIEW AND SECTION THROUGH BRICKWORK SETTING OF "LANCASHIRE" TYPE BOILERS WITH CROSS WATER TUBES.

Calling Tenders

The steam pressure for our proposed boiler will, of course, be known from our engine requirements as to power. Having, therefore, determined that we need a boiler having 1,000 sq. ft. of heating surface and capable of burning 500 pounds of coal on the fire grate per hour, tenders may be asked from builders of various types of boilers. It may or may not at this stage be advisable to enumerate any special conditions to be fulfilled, leaving, instead, the boiler-maker to feature these as far as his product is concerned by general direction only. In any case, more or less valuable data as to boiler performance is sure to be made available to us by the different tenderers, and may in the end upset any previously-conceived ideas we held, or at least add to our existing knowledge of steam generators and their new possibilities.

Local Conditions

Notwithstanding the foregoing, the choice of type and dimensions of our boiler to give the best heat efficiency involves many difficulties, and these have to be faced on going over the various tenders received. Irrespective of the latter, our own views on and knowledge of local conditions must be carefully considered and weighed. Among these the following are important:—Nature of feed water used; space available for boiler installation; value of chimney draft; cleaning facilities; whether steam required is a constant quantity, or if varying several times per hour or per day; whether smoke from the stack is liable to be reckoned a nuisance or even an offence; nature of fuel—oil, wood, sawdust and shavings or coal; if the latter, whether dust, medium, or large pieces, much or little clinker, smoky or otherwise, and high or low heating value.

The nature of the feed water need not too seriously affect the choice of a boiler, as, should a material advantage be apparent in one type, it would be worth while, under any circumstance, to install a filter, purifier or water softener, as the case may be.

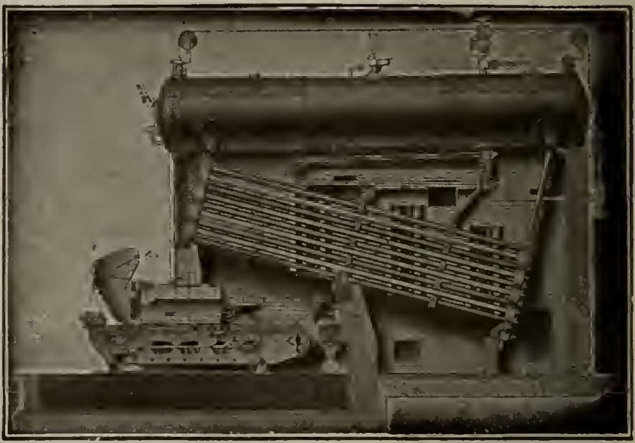
The Safety Feature

The safety of the boiler should constitute the prime factor in any choice made. Additional boilers that may be installed should also be considered in the light of space and battery arrangement provision, and possible also economizer space should be reckoned if forced steaming at some future time has to be resorted to. One type of boiler, generally speaking, is as good as another as regards efficiency of operation when properly tended. It is important that the furnace gases do not escape to the stack at too high a temperature. Steam and water spaces should be considered relative to the possibilities of priming. Other conditions being equal, one large boiler is preferable to two small ones. A spare boiler is worthy of consideration at any time, enabling as it does laying off a unit for periodic cleaning and overhaul.

Value of Boiler Inspection

The safety of all boilers depends on thorough and systematic inspection, inside and out, and such attention as the operative staff give in that direction may well be supplemented by that procurable from insurance placed with a reputable boiler insurance concern. The latter's charge, comparatively speaking, is trifling. With proper care and inspection of every square foot of boiler surface, explosions from weakness, rusting away of the plates or fitting, are impossible. All boilers should be inspected both inside and out at least once a year.

Boiler explosions, as Longridge has said, are chiefly due to rusting, bad construction or bad treatment, being natural consequences in most cases of defects that were not seen, because not particularly looked for. The actual condition of any boiler can only be determined from a thorough examination by a competent, well-trained, and experienced inspector. Every part should be looked at, as any part may be defective, and that possibly where least expected. The water or steam pressure test does not necessarily ensure desired safety, these being but of the series of means adopted to secure the latter end.



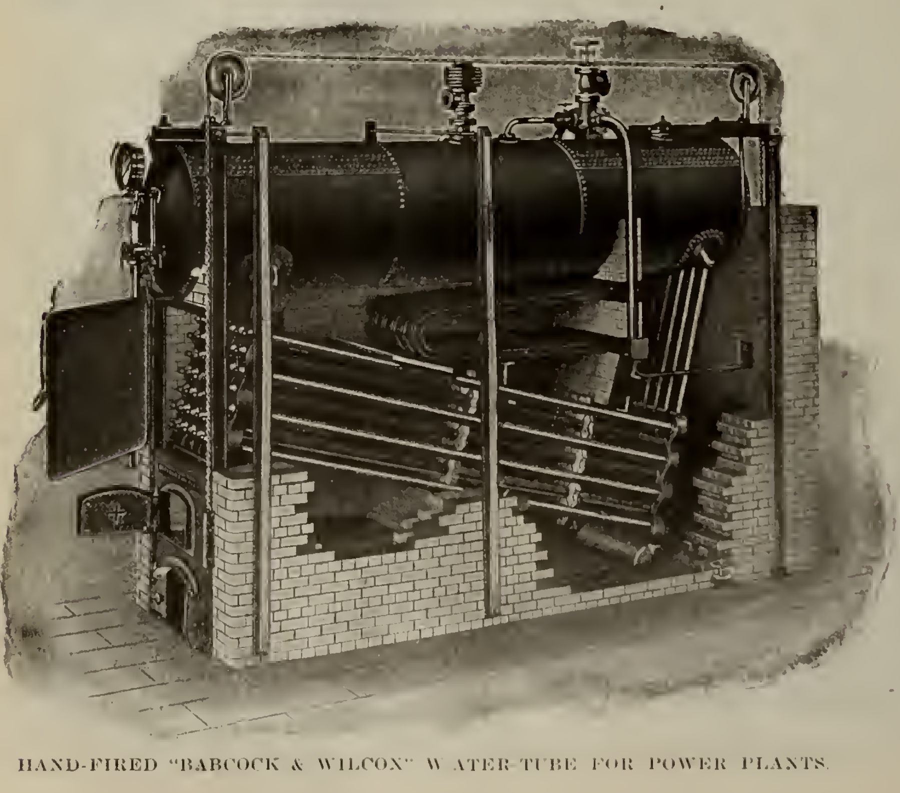
"BABCOCK & WILCOX" WATER-TUBE BOILER WITH SUPERHEATER AND CHAIN GRATE STOKER.

Rules for Builders

The sacrifice of quality of material and workmanship, fortunately little practised anywhere, in order to turn out a low price product, is not only false economy, but near-criminal. Well proven, safe-of-adoption rules covering boiler design and construction, and applicable to all types and pressures, have been formulated for the boiler builder's guidance. Although varied in form and differing somewhat in substance, satisfactory results are for the most part the outcome of the adoption of any one set for the boiler as a whole or for an individual component.

Rules for Attendants

Rules and regulations for the guidance of the boiler attendant, for inspection and testing of boilers have been prepared from wide and varied practical experience, so that in neither their care nor relative to the builder may excuse be found for neglect of their observance. It has been said with regard to steam boilers, in their every phase and feature, that he would indeed be a rash man who sought to depart to any appreciable extent from either of the prescribed rules and regulations. In general practice we find little disposition to leave the beaten path.



HAND-FIRED "BABCOCK & WILCOX" WATER-TUBE FOR POWER PLANTS.

Question and Answer Series

Question.—What is the minimum monthly coal consumption that will warrant the installation of an ash conveyor in a boiler plant?

Answer.—Naturally the problem depends on the percentage of ash in the fuel and various local conditions, such as construction of power-house, manner in which ash must be disposed of, etc. Speaking generally, where the furnace refuse is approximately 12½ per cent. of the coal fired, and with the usual arrangement of power-house, an ash conveyor may be found profitable when the monthly coal consumption exceeds 2,500 to 3,000 tons.

* * *

Question.—Other conditions being the same, does the over-all efficiency of boiler furnaces vary as between small isolated heating or power plants and large central power stations?

Answer.—Theoretically the over-all efficiency of large furnaces should be higher, because radiation losses are proportional to the extent of the external surfaces, while the work done, other things being equal, is proportional to the cubical contents. It is assumed, of course, that the comparison is between furnaces of similar proportions. In ordinary practice, however, the radiation losses are masked by other much larger losses, and it is only when these other losses are measured or eliminated that the effect due to reduced ratio of radiating surface can be recognized. The ordinary isolated heating or power plant is less efficient than that of the large central station, not because the furnace or boiler units are small, but because a hundred rules of good practice which are followed by the central station boiler room superintendent are either unknown to or are neglected by the isolated plant engineer, who usually has troubles enough of the boiler room.

* * *

Question.—Size of engine being given, how may size of generator for direct connection be determined?

Answer.—For a direct-current generator, 0.746 × engine brake horse-power equals the equivalent kilowatt capacity of the engine, which will be the power input to the generator. Multiplying this quantity by the assumed efficiency of the generator gives the kilowatts output of the generator. The efficiency may be assumed to be 90 per cent., which is an average value. Thus 0.90 × 0.746 B.h.p. = the kilowatt rating of the generator. In the case of an alternating-current generator the rating as found above must be divided by the power-factor at which the generator is to be rated to determine the k.v.a. rating. The above is based upon the assumption that brake horse-power is known. In case it is not known it may be found by multiplying the indicated horse-power by the engine efficiency, an average value of which is taken as 0.90. The generator which is selected should have the same approximate overload capacity as the engine.

* * *

Question.—The brake horse-power of a steam engine is 60, and the indicated horse-power is 75; from this data determine the mechanical efficiency and state same in percentage terms.

Answer.—Multiply the brake horsepower (b.h.p.) by 100, and divide the resultant total by the indicated horsepower (i.h.p.). Stated as a formula, mechanical efficiency $= \frac{60 \times 100}{75} = 80$ per cent.

* * *

Question.—The area of an indicator diagram from a simple steam engine is 3 square inches; its length is 4 inches, and the spring used on the indicator piston is rated as 100. The diameter of the engine cylinder is 15 inches, the stroke 24 inches, and the working speed 150 r.p.m.; calculate the indicated horsepower.

Answer.—The first procedure in answering this question is to find the average height of the diagram, and this is got by dividing the area by the length, both of which are given. Average height of diagram $= \frac{3}{4} = .75$ inch. As each inch in diagram height represents 100 pounds pressure, the spring rating being 100, multiplying the average height by 100 will give us the mean pressure exerted on the piston in the direction in which the engine is moving. Thus, $.75 \times 100 = 75$ pounds.

The indicated horse-power (i.h.p.) is found by multiplying together the above mean pressure, twice the length of engine stroke in feet—there being two strokes in each revolution, the area of engine piston in sq. inches, the revolutions per minute, and dividing the result by 33,000, which is the foot-pound representation and standard for one horsepower. Area of engine piston is found by multiplying its diameter by itself and by .7854, or as may be more compactly expressed, squaring the piston diameter and multiplying by .7854. Thus, $15^2 \times .7854$, or $15 \times 15 \times .7854 = 176.715$ sq. ins. piston area on which mean pressure acts. The stroke of the engine is 24 inches, and this divided by 12—there being twelve inches in one foot, gives us a 2-ft. stroke.

We now multiply together 75 pounds mean pressure, twice the 2-ft. stroke, the piston area of 176.715 sq. inches, and the revolutions per minute, 150, and divide the result to get the indicated horsepower. Thus, $\frac{75 \times 2 \times 2 \times 176.715 \times 150}{33,000} = 240.975 =$ indicated horse required.

* * *

Question.—When a steam boiler is under pressure, to what particular strain is the shell subjected?

Answer. — Under either steam or hydraulic pressure, the shell of a boiler comes under a tensile or tearing-apart strain in the girth direction of the plating. On this account, what is known as the ultimate tensile strength of the shell plate material is used in calculations pertaining to any proposed or to-be-determined working steam pressure.

* * *

Question.—A water-tube boiler contains 120 tubes of 4 inches outside diameter and 16 feet long. What is the total tube heating surface in sq. ft.?

Answer.—The circumference of a 4-inch diameter tube is the first requirement, and this is found by multiplying the diameter by 3.1416. Thus, $4 \times 3.1416 = 12.5664$ inches. It will be noted that the heating surface required is expressed in sq. ft., and as this is recognized practice, it becomes necessary to convert the 12.5664 inches circumference of one 4-

inch tube into feet. This is done by dividing the total inches by 12. Thus,

$$\frac{12.5664}{12} = 1.0472 \text{ feet.}$$

Multiplying 1.0472 by 16, which is the tube lengths given, we get $1.0472 \times 16 = 16.7552$ sq. ft. as the heating surface of one tube. This in turn multiplied by 120, thus, $16.7552 \times 120 = 2010.624$ sq. ft., gives us the total tube heating surface.

Stated as a compact formula, total tube

$$\text{heating surface} = \frac{3.1416 \times 4 \times 16 \times 120}{12} = 2010.624 \text{ sq. ft.}$$

* * *

Question.—With a high degree of superheat, what precautions are necessary over and above those taken for saturated steam?

Answer.—Careful design and constructional detail of the stop valves and steam piping between the superheater and the engine, also of the piston and valve of the first cylinder into which the superheated steam enters become imperative. An efficient and reliable system of cylinder lubrication is also an absolute necessity.

* * *

Question.—What are the two systems generally employed to superheat saturated steam?

Answer.—The first and most common arrangement consists in placing the superheater in the flue space of the boiler to abstract the necessary heat from the hot gases. The second arrangement depends on a separate furnace for imparting the superheat.

* * *

Question.—To what strains are the piston and connecting rods of a steam engine subjected when the latter is in operation?

Answer.—When the piston is moving toward the shaft, they are each under a compressive strain and on the return stroke they are subject to a tensile strain. The compressive strain is the more severe, hence the practice of increasing the connecting rod diameter at the middle of its length or of tapering it from inner to outer end.

* * *

Question.—What is meant by the expression "capacity" as applied to pumps and pumping engines?

Answer.—By "capacity" is implied the quantity of water delivered in a given time. It is expressed as thousand gallons per hour or million gallons per 24 hours, according to size of unit.

* * *

Question.—What steps should be taken and precautions adopted before admitting steam to pipe lines or to an engine?

Answer.—All drain cocks should be opened fully, it having been previously ascertained that the passages in same and those of their connecting pipes to drains or traps are free from obstruction. As regards stop valves on piping or on the engine, these should be opened quite gradually, so as to allow the piping or engine to warm up slowly and become cleared of the water of condensation before the full head of steam comes upon them.

* * *

Question.—With the pressure of steam still on the pipe line, what condition is likely to be produced and what eventuality may be expected if a stop valve or drain cock is opened on a range of piping, known to contain water or where the latter possibility may exist?

Answer.—There is grave danger under the conditions stated, "water hammer" being almost certain to ensue, followed by burst pipes and valves, and possible disastrous explosion in the zone immediately affected. If a pipe, which is under steam, is believed to contain water, the boiler or other stop valve involved should be closed, after which the drain cock may be opened, and the water run out and steam again slowly admitted to the piping. When steam is not required, it should be shut off and all drain cocks opened on the piping or cylinders.

* * *

Question.—The belt flywheel on a horizontal engine is 10 feet in diameter and runs 100 revolutions per minute, what is the belt speed in feet per minute?

Answer.—Multiplying the flywheel diameter in feet by 3.1416, we get the number of feet in the circumference of the flywheel, or what amounts to the same thing, the number of feet that the belt travels in one revolution of the engine. Thus, $10 \times 3.1416 = 31.416$ feet. Multiplying this result by the engine revolutions per minute, we arrive at the belt speed in feet per minute. Thus, $31.416 \times 100 = 3141.6 =$ belt speed in feet per minute. Stated as a compact formula, $10 \times 3.1416 \times 100 = 3141.6$, or belt speed in feet per minute. Where the diameter of belt flywheel contains odd inches, as for instance, with a diameter of 106 inches, it becomes necessary to bring the inches to a basis of feet. This is done by dividing 106 by 12, there being 12 inches in one foot. Thus,

$$\frac{106}{12} = 8.8333 \text{ feet diameter.}$$

Taking the example as given in the original question and calling the flywheel diameter 120 inches instead of 10 feet, the formula

$$\text{would become } \frac{120 \times 3.1416 \times 100}{12} = 3141.6$$

feet of belt speed per minute, as already stated.

Question.—Under what special circumstances is it desirable to use rubber belting in preference to leather?

Answer.—Rubber belting should be ininstalled wherever the drive is exposed to the elements, or when the drive is located in a damp or steamy enclosed place. Leather belting is believed, however, to give cheaper service and to last longer under normally favorable conditions. The life of leather belting, as indeed any type of belting, depends largely on the manner of application or nature of drive, and the amount of care and attention bestowed.

* * *

Question.—Enumerate some of the advantages to be derived from keeping an accurate record of the amount of feed water supplied to the boiler or boilers in a steam power plant?

Answer.—It enables the boiler efficiency to be determined; or, in other words, gives easily appreciable evidence of the heat units recovered per pound of fuel. Choice can be made of the grade or class of fuel to employ so as to secure the highest attainable efficiency and economy as a combination. Firing methods and capabilities of different firemen may be brought under review. Air leaks in boiler settings, leaky boiler mountings, determination of comparative efficiencies between scaly and sooty heating surfaces, and last, but not least, the decidedly uplifting moral tendency on the part of the operators to maintain the standard of efficiency of service which a feed water recorder insists that they attain to, are a few other advantages likely to accrue from the installation of the necessary apparatus.

* * *

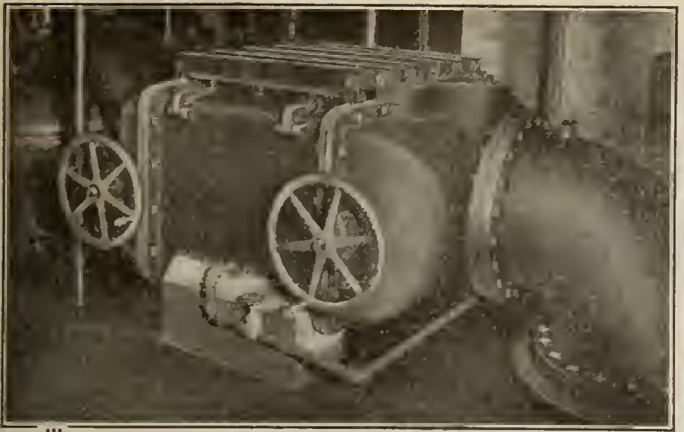
Question.—What line of action should be taken or procedure adopted when firing a boiler to ensure the best possible results in steam raising and pressure maintenance?

Answer.—When stoking, do it quickly and regularly, and keep the firebars evenly and well covered. Throw the coal only where it is required. Do not use the rake unless the coals cake considerably, and the fire cannot be kept level without it. Keep the fire-doors open as short a time as possible. Never allow the bars to become bare. If too much cold air gets in, less steam will be raised, and the fuel wasted.

* * *

Question.—What advantage has the piston valve over the ordinary slide valve, and in what circumstances is it used?

Answer.—It is more perfectly balanced, being as nearly as possible in equilibrium, thereby reducing the strain on the valve rod and gear due to valve and valve face friction. It is used in preference to a slide valve for the above reason, when the working steam pressure is high and when the necessary slide valve would be of large area.



24" Twin Strainer in condenser circulating water line.

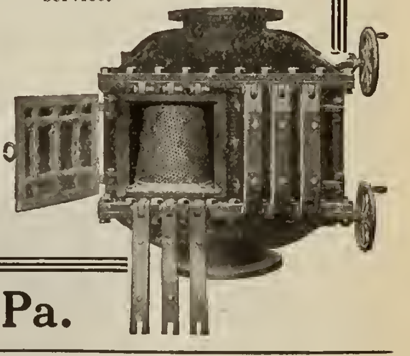
Twin Strainers

Insure Continuous Service

The Twin Strainer stands on guard twenty-four hours a day, and removes from the water all such foreign matter as dead leaves and grass, sticks, fish, etc., that would clog up and injure the pump and condenser.

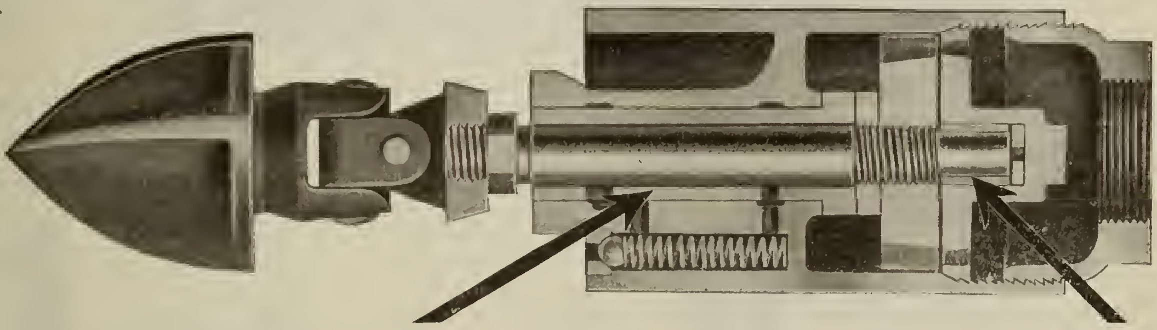
The Twin Strainer is the only direct-flow strainer that can't be clogged. When the solids accumulate in one of the two straining baskets, a clean one is put in service by simply operating two valves. The dirty basket can then be lifted out, carried to a convenient place, cleaned, and replaced in the Strainer—all this without interrupting the supply of water for an instant.

Twin Strainers are made in sizes ranging from 1 to 48 ins. with perforations in the straining baskets to suit your service.



Twin users are the best boosters we have. Send for a copy of Bulletin "A" and join the army.

Elliott Company, 6902 Susquehanna St., **Pittsburgh, Pa.**



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Because the weight of the rotating parts is so small that the friction load on any type of bearing in good condition is negligible compared with the load of removing scale.

BUT—there is a shock load due to vibration. And you know that ball and roller bearings will not stand up under shock. And it is impossible to keep the grit and dust from the scale out of ball or roller bearings.

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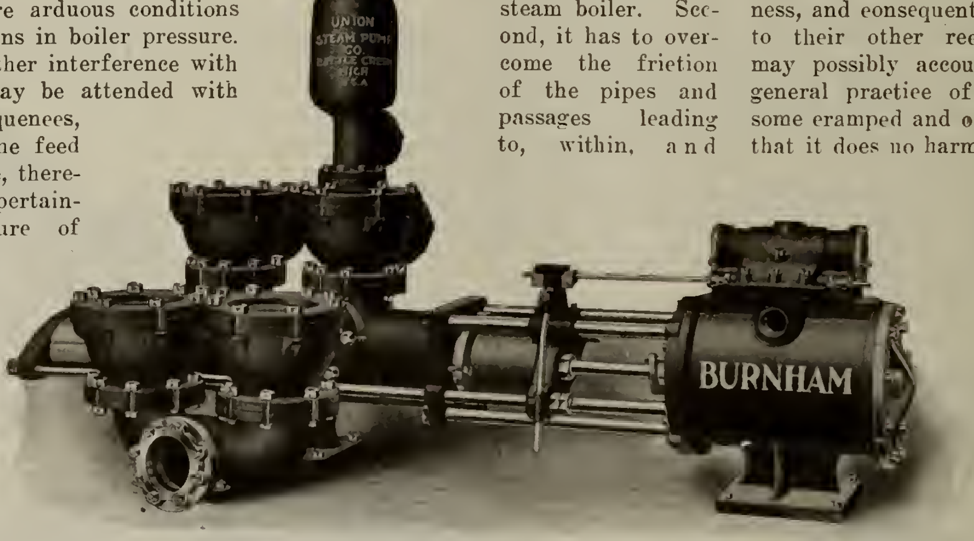
Steam Power Plant Auxiliaries

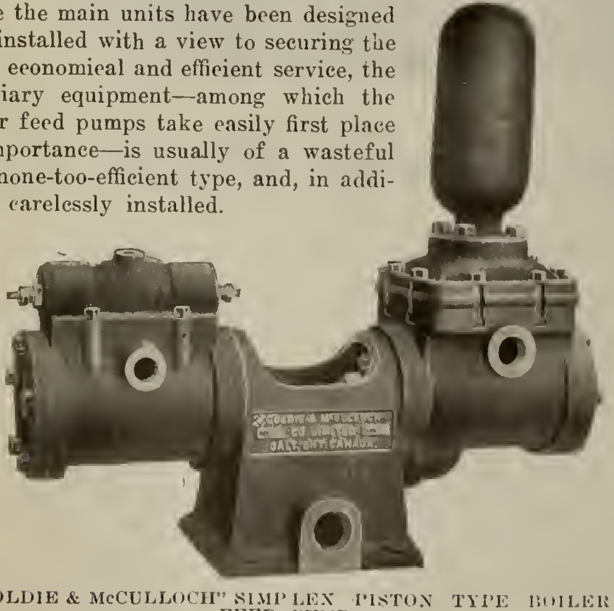
BOILER FEED PUMPS

THE first consideration in a boiler feed pump is that it be thoroughly reliable in service. It works as continuously as the main engines, and usually under more arduous conditions as regards variations in boiler pressure. A breakdown or other interference with the boiler feed may be attended with very serious consequences, whether due to the feed pump or otherwise, therefore everything pertaining to this feature of steam plant equipment should be characterized by certainty of action, economical operation, excellence of design, workmanship and material, simplicity of arrangement and easy access to all working parts.

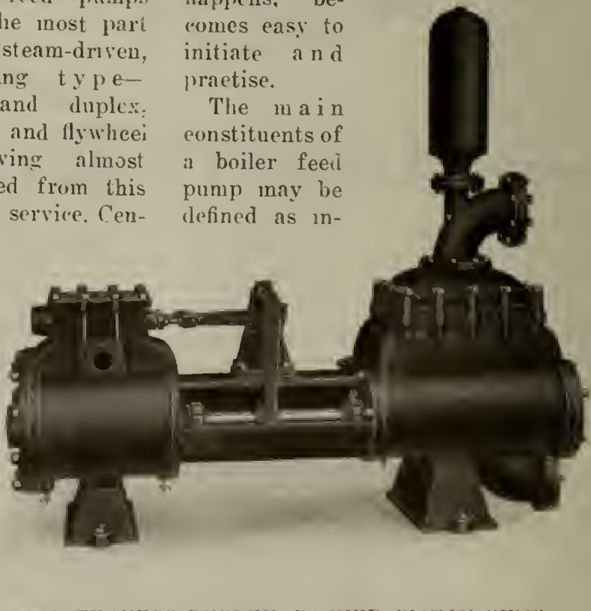
In all power plant installations, whether afloat or ashore, there exists to a lesser or greater extent the anomaly that while the main units have been designed and installed with a view to securing the most economical and efficient service, the auxiliary equipment—among which the boiler feed pumps take easily first place in importance—is usually of a wasteful and none-too-efficient type, and, in addition, carelessly installed.



“DARLING BROS.” OUTSIDE PACKED PLUNGER PUMP-POT VALVE PATTERN.



“GOLDIE & McCULLOCH” SIMPLEX PISTON TYPE BOILER FEED PUMP



“SMART TURNER” DUPLEX, PACKED PISTON PUMP.

The work to be performed by any type pump may be considered as of three kinds:—First, it has to overcome the head to be pumped against, as when it discharges against an ordinary head of water, or what amounts to the same thing, when it discharges against a fluid under pressure, as in the case of a steam boiler. Second, it has to overcome the friction of the pipes and passages leading to, within, and from itself. Third, it has to exert a pressure to cause the discharge to take place at some required velocity.

Boiler feed pumps are for the most part of the steam-driven, direct-acting type—simplex and duplex, the crank and flywheel type having almost disappeared from this particular service. Centrifugal, or, more properly speaking, turbine pumps, are finding a sphere of usefulness in boiler feeding, being driven either by steam turbine or electric motor.

Steam-driven, direct-acting, boiler feed pumps, whether simplex or duplex, are built of both horizontal and vertical pattern, although we believe the former predominates. In either case, compactness, and consequently space-saving, add to their other recommendations, and may possibly account for the almost general practice of installing them in some cramped and out-of-the-way corner that it does no harm to fill, but that nothing appears to fit in so perfectly as does a boiler feed pump. This, of course, is not as it should be, either in justice to the pump mechanism and its maker, or to the scheme of plant efficiency which should be existent. Neglect, wilful or through indifference, due to the unit being more or less out of sight, and, therefore, more or less out of mind, until something happens, becomes easy to initiate and practise.

The main constituents of a boiler feed pump may be defined as involving a steam and water end, all makes and types, of course, being included in the definition. In the simplex type the steam end is em-

In Manufacturing Plant or Office Building—

DEARBORN TREATMENT

In Laundry, or Textile Mill—

In Hospital, or Hotel, or Apartment House—

In Breweries or Ice Plants—in Mines.

In every industry where economical, efficient operation of the boiler plant is desired—Dearborn Treatment is the right thing to use to keep the boilers free from scale-forming elements—free from elements that cause pitting, corrosion or other troubles chargeable to bad boiler water.

Dearborn Treatment is made to meet actual conditions—**it is not a cure-all.**

Every barrel of Dearborn Treatment that leaves our works is made to counteract the troublesome elements which a thorough analysis of the feed water has shown to exist at the plant for which it has been prepared.

That's why every barrel of Dearborn Treatment gives satisfactory results.

Send a gallon of your boiler feed water for analysis and let us advise regarding treatment. Dearborn Treatment is applied constantly with the feed water, old scale is removed and new incrustation, corrosion, pitting, bagging and other injurious action prevented.

Boilers last longer, repair bills are eliminated, no long shut-downs required, and fuel bills are greatly reduced.

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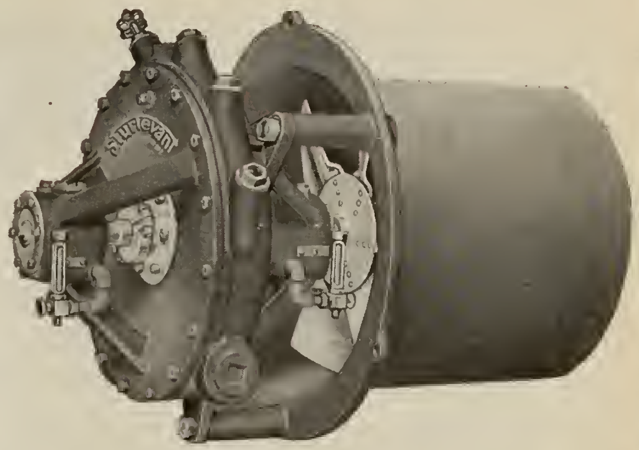


Greater Boiler Capacity with Cheaper Fuel

Perhaps you would like to burn a cheaper grade of coal—perhaps dust or screenings. Under present conditions you have not sufficient draft to do this without decreasing your steam capacity to such an extent that you could not supply the demand.

If such is the case why not install a Sturtevant Turbo-Undergrate Blower? This little machine will give you sufficient draft to burn any grade of coal—and this is not mere theory but we have effected actual savings, and one of our customers is saving 9% on his fuel bill.

It may be that you are short of steam, and the trouble is so great that you are faced with the problem of building a higher stack or of adding additional boilers.

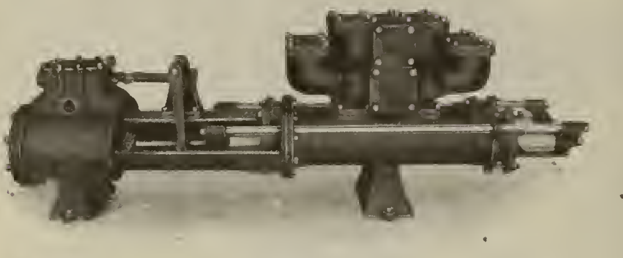
The Sturtevant Blower will do equally well at only a small fraction of the cost—occupies no floor space—installed over night.

Send us complete details and we will make recommendations suited to your conditions. Get catalog 214-U.

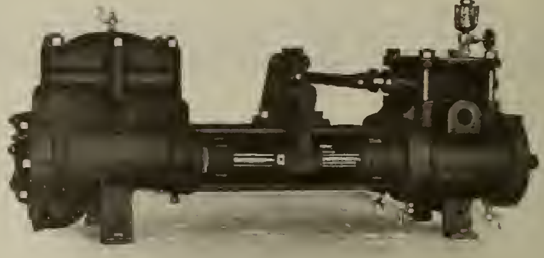
B. F. Sturtevant Company
of Canada, Limited
GALT, ONTARIO, CANADA
MONTREAL TORONTO WINNIPEG VANCOUVER

Selling Agents. Sanford Riley Stoker Co., Ltd.,
"THE RILEY STOKER"

bodied in a single cylinder, the water or pump end being similarly constituted. In the duplex type, on the other hand, a combination of two steam cylinders operates on a combination of two water cylinders. Applicable to both of the foregoing is the compound and triple expansion arrangements, consisting of high and low, and high, low and intermediate pressure steam cylinders respectively, placed tandem fashion. In these latter designs it may be mentioned at this stage that the purpose is to use the steam required for operation expansively.



"SMART-TURNER" DUPLEX, OUTSIDE END PACKED PLUNGER PUMP WITH POT VALVES.



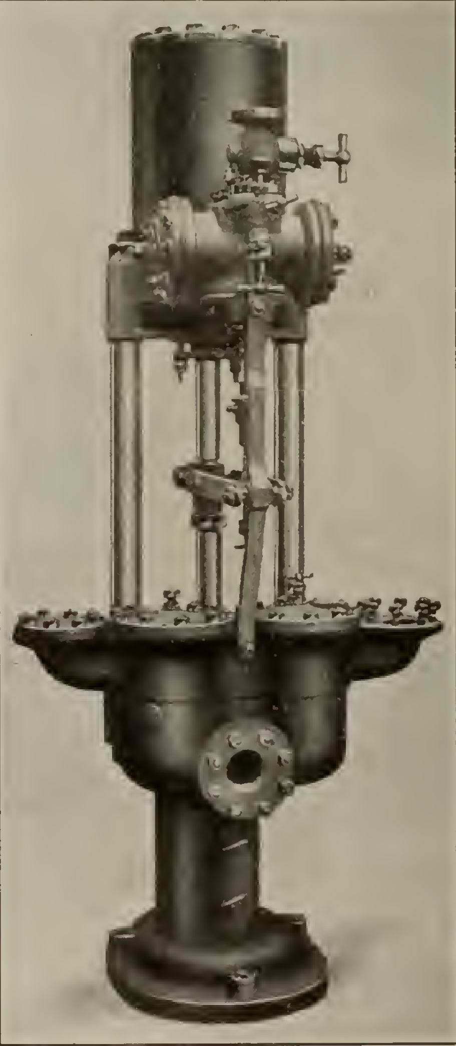
"SMART-TURNER" DUPLEX, PACKED PISTON PUMP

Water ends of boiler feed pumps may be either of the piston or plunger type, arranged double-acting in all cases. Relative to the plunger type, the pump may be known as either outside centre packed, or outside end packed. For the most part steam and water ends of different makes vary in their constituent design and detail, as a consequence the operative and connecting mechanisms vary correspondingly. All, however, are designed and manufactured with a view to attaining the same comprehensive service ideal; it is not, however, within the scope of this series of articles to make comparison or draw distinctions.

Boiler feed pumps, as indeed all pumps of the reciprocating type, should embody to the fullest extent possible the features of moderate speed, quiet operation, absence of a dead centre, the ability to start up from any part of the stroke, uniform length of stroke with varying speeds and pressures, most economical steam consumption possible, minimum clearance spaces, strength and suitability of material of their make-up to withstand the service pressures to which they are subjected, and to keep tear and wear at a minimum, etc.

In a subsequent article the more prominent designs and types of boiler feed pumps being manufactured for power plants, large and small, will be individually described and illustrated, the latter, for the most part by means of sectional drawings, so that readers may become thoroughly familiar with the various details and mechanisms entering into each complete unit. The component parts of boiler feed pumps are in the main delicate of construction, adjustment and handling, and it is not beyond the range of possibility that a new interest may be awakened and a more intelligent conception of their care and treatment be the immediate result of perusal of the featured products of the various makers.

Before entering on this phase of our subject, however, it seems meet that operators and others concerned should become conversant with the guidance and instruction offered by manufacturers, particularly relative to installation, operation care, adjustment and trouble investigation of boiler feed pumps. It may be said that there is complete unanimity of advice on these various points and specific instruction is always available with reference to details of individual pump products.



"WEIR" STANDARD BOILER FEED PUMP FOR POWER PLANTS.

Installation and Other Features

When installing a boiler feed pump, it is always desirable that the pump should be located so that the water will flow into the pump. This feature is absolutely essential in the larger sizes and 'where hot water is to be handled', because a pump cannot lift hot water by suction.

It is recommended that a boiler feed pump should not be run faster than 35 ft. per minute, and it is much more desirable to run the pump 20 or 25 ft. per minute. This not only gives the engineer a large reserve capacity should he have to force his boiler in case of emergency, but it prolongs the life of the pump and decreases the repair bill.

It is also desirable to locate the pump as near the source of supply as possible. If a feed water heater is used, put the pump within two or three feet of the heater, or if not possible to do this, raise the heater three or four feet above the pump so that you are positive that there is sufficient head of water to overcome the frictional resistance of the suction pipe and make the water flow into the pump.

For general service, such as handling cold water, it is permissible to run the pump at a much higher speed than given rated capacity. The speed will depend on the material handled. If the liquid handled is clear, cold water, the pump may run from 75 to 100 feet per minute. If the water is warm, it must run more slowly, or if the suction lift is high, the pump should not be expected to run at maximum speed. In no case should the pump be expected to lift water by suction more than 22 feet.

The suction pipe should be as straight as possible, and as free as possible from bends and elbows, but, where these cannot be avoided, the suction pipe should be made one or two sizes larger than the pump suction, and a suction air chamber should be installed. This usually consists of a vertical length of pipe no smaller than the suction of the pump and from 4 to 6 feet high, capped over at the top and provided with a pet cock to insure that it is filled with air.

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"AMERICAN" STEAM and POWER DRIVEN PUMPS

They are the result of over twenty-five years' experience in the design and construction of high-grade pumping machinery. Note the heavy, solid construction. Solid bronze piston rods and heavy cast bronze removable water cylinder bushings. Steam ends of the latest and most approved balanced piston type, mechanically actuated. Our slogan is: Simplex not Duplex, "To be simple is to be great."

Have you received your copy of our new Bulletin Catalog?

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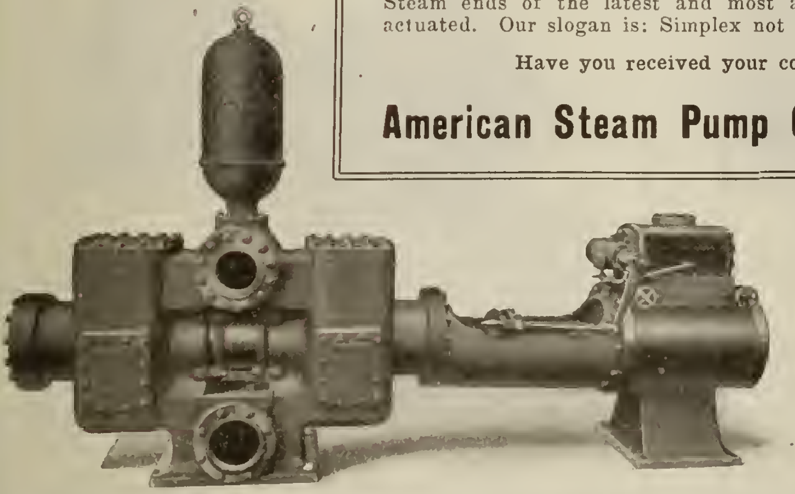

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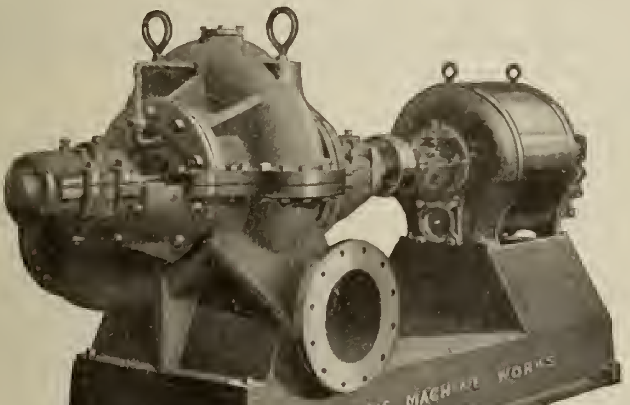

Accessible Pumps

The "Morris" Horizontally Split Shell Centrifugal Pump is very popular with pump users — can be inspected quickly without breaking pipe connections.

THE LATEST UP-TO-DATE DESIGN BACKED BY HALF A CENTURY'S PUMP EXPERIENCE

The cut shows a steam turbine driven pump, the same design being used for motor and other drives. We build centrifugal pumps for all services, including BOILER FEEDING, TANK PUMPING, GENERAL WATER SUPPLY, BRINE WORK, ETC. Send us your inquiries for pumps of all types.

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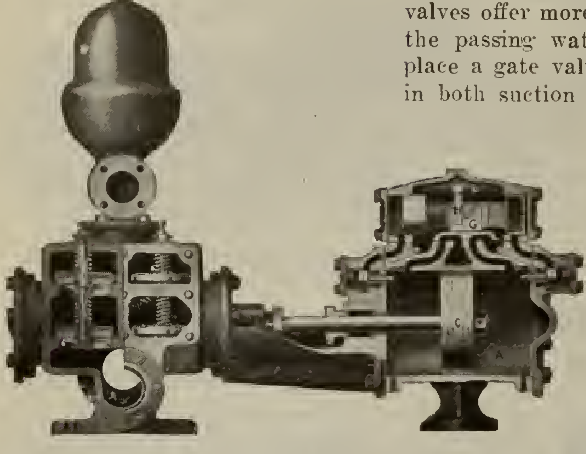
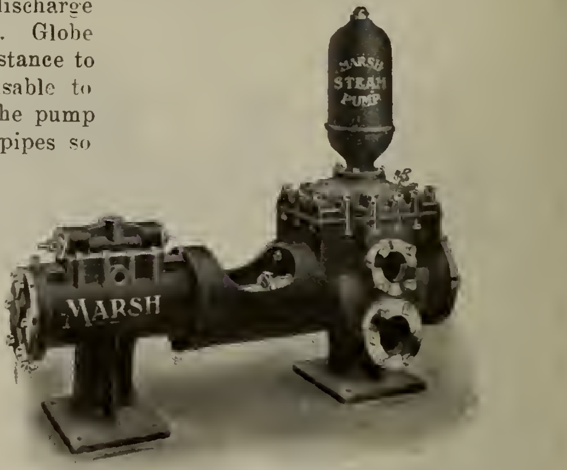
Canadian Sales Agents for
MORRIS MACHINE WORKS, BALDWINSVILLE, N.Y.

though this pet cock need not be left open. The office of this suction air chamber is to keep a continual flow of water passing through the suction pipe. The water will surge into the suction air chamber when the pump reverses, thus avoiding water hammer, which might cause trouble to the pump or to the pipes.


SECTION THROUGH "A. S. CAMERON" SIMPLEX DOUBLE-ACTING PISTON TYPE BOILER FEED PUMP.



"MARSH" SIMPLEX, PISTON TYPE, BOILER FEED PUMP.

The discharge pipe should be large and free, but this is not as essential as it is with the suction pipe.

Blow out steam pipe thoroughly before connecting up your pump. Any dirt or rubbish carried into a steam cylinder will cut and wear it away.

In cold weather, open the drip cocks to drain the steam and water cylinders, otherwise they may burst if allowed to freeze.

Suction pipe must be absolutely tight, and it is always well to use a foot valve and strainer.

Do not use tallow in the steam cylinder, but a little of the best refined mineral, sperm or lard oil. Any oil that corrodes or gums the working parts is unfit for use. Oil steam end just before stopping pump.

Keep stuffing boxes full of good packing, well oiled, and just tight enough to prevent leakage without excessive friction.

See that the pump has always a full and steady supply of water.

If the pump commences to run badly, make sure that the water end-valves and piping are right before examining the steam end.

In running piping to or from the pump, avoid all possibility of the formation of air pockets.

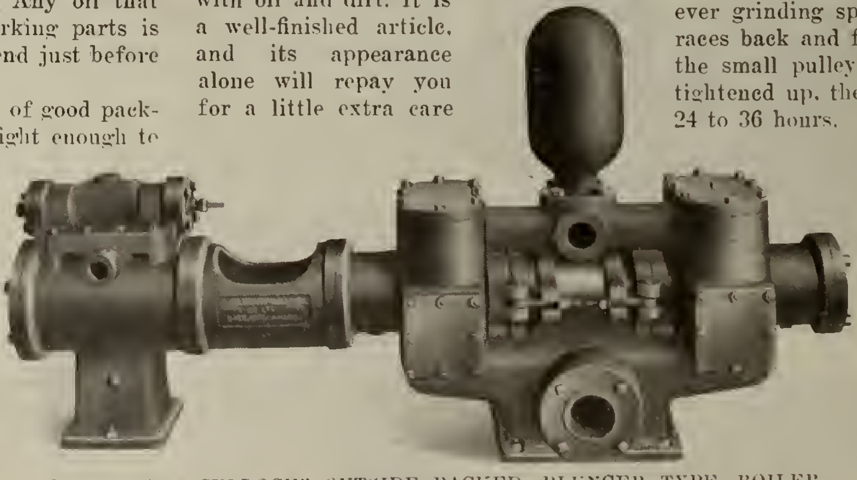
The suction pipe should in no case be smaller than that given by the maker of the pump. If the pipe is long, it must be larger as the friction due to the excessive length will partly overcome the head due to the vacuum and prevent a full supply of water. Give the suction pipe a uniform grade of about 6 inches per 100 feet towards the supply source.

All valves in suction and discharge piping should be "gate" type. Globe valves offer more frictional resistance to the passing water. It is advisable to place a gate valve at or near the pump in both suction and discharge pipes so that the pump may be isolated if need be for examination.

A relief valve of ample size, and set at slightly higher pressure than that against which the pump operates, should be placed between the pump and any shut-off valve in the discharge line, in order to avoid damage to the pump if the latter is started up with the feed check or other shut-off valve closed.

Pump valves should be examined occasionally to see that they are seating properly. Foreign substances are apt to be drawn up through the suction pipe and become lodged between a valve and its seat, causing leakage and a corresponding reduction in pump capacity.

Don't let your pump get covered up with oil and dirt. It is a well-finished article, and its appearance alone will repay you for a little extra care in keeping it neat and clean.


"GOLDIE & McCULLOCH" OUTSIDE PACKED, PLUNGER TYPE, BOILER FEED PUMP.

Don't expect the pump to feed quietly with the water in the supply tank partly below the top of the suction pipe, or if the pump is otherwise drawing air.

Don't leave the pump to rust if it is not required for a time. Take off the covers and oil the slide valves, piston, etc.

Don't let things hang. If you see there is something the matter, find out what it is at once and get it put right.

READERS' QUERIES FOR READERS' ANSWERS

WHY will water that has been subjected to heat freeze quicker than that which has not been heated?

Why does water that has been heated take more heat to reheat it again?

Explain why atmospheric humidity affects people when the temperature is high, such as in the case of sunstroke? Does it have any effect in a low temperature?—Subscriber.

• • •

I have trouble with the belt that drives the grinder in our mill, and would like some advice concerning same. Various belts tried give no relief. Whenever grinding speed is reached the belt races back and forth across the face of the small pulley. By keeping the belt tightened up, the lacing only lasts from 24 to 36 hours. The pulleys are in good balance, and run true, so far as I can judge. Particulars of the equipment and drive are as follows:—Coal oil engine of 25 horse power, running 290 r.p.m.; belt pulley on engine, 40 inches diameter; belt pulley on line shaft, 20 inches diameter; belt pulley on line shaft for grinder drive, 48 inches, belt pulley on grinder, 7½ inches diameter; grinder speed required 3500 r.p.m. With the belt pulleys as above installed and the engine revolutions given, what is the grinder speed and belt velocity?—Cottam

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BOILER FEEDER

Operates on 1-10th the steam that it takes to run a steam pump, and returns condensation to boilers at 300 **DEGREES FAHRENHEIT.**

The "Cole" operates with the utmost in efficiency and reliability, and returns condensation at any pressure.

Operates on roller bearings, on a fixed Fulcom which permits of FULL DISCHARGE AT EACH OPERATION.

Saves water, oil, time and an enormous amount of fuel.

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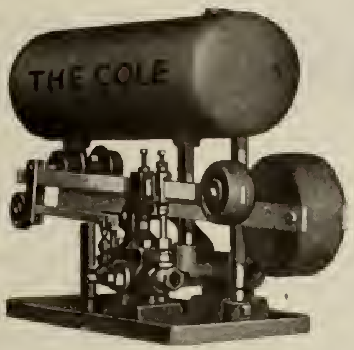

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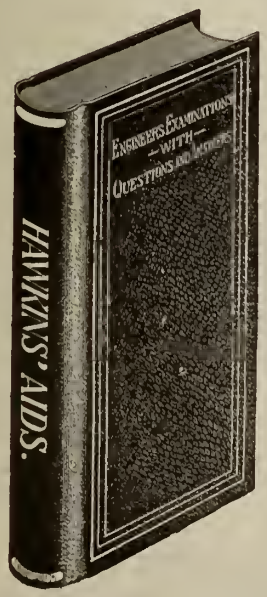

This work is an important aid to engineers of all grades, and is undoubtedly the most helpful ever issued relating to a safe and sure preparation for examination. It presents in a condensed form the most approved practice in the care and management of Steam Boilers, Engines, Pumps, Electrical and Refrigerating Machines, also a few plain rules of arithmetic with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the Steam Engine and Steam Boiler.

It contains various rules, regulations and laws of large cities for the examination of boilers and the licensing of engineers.

The book gives the underlying principles of steam engineering in plain language, with very many sample questions and answers likely to be asked by the examiner.

It also gives a short chapter on the "Key to Success" in obtaining knowledge necessary for advancement in engineering.

This helpful volume contains 200 pages of valuable information not elsewhere obtainable; it is bound in rich red leather with full gold edges and titles; it measures 5x7½ inches and weighs twenty-two ounces.

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Centrifugal Blowers and Compressors

OUR policy of making overall steam consumption guarantees on all De Laval steam-turbine-driven apparatus, including centrifugal blowers and compressors, is helping to introduce high efficiency fans and blowers. It pays in the long run to buy De Laval units, because of greater overall economy.

DE LAVAL centrifugal blowers and compressors for all volumes and for all pressures from 5 inch water column for mechanical draft, up to 125 lb. per square inch, are built in the same shops, by the same methods and from the same high grade materials that have been responsible for the high reputation of our other products.

OUR Catalog F61 on Centrifugal blowers and Compressors treats of characteristics and application of such apparatus.

De Laval Steam Turbine Co.

TURBINE EQUIPMENT CO., LIMITED
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GENERAL AND CONDENSER SERVICE CENTRIFUGAL PUMPS

OUR illustrations refer to a line of horizontal and vertical shaft centrifugal pumps for general services and for condenser work, being built by the Wheeler Condenser & Engineering Co., of Cartaret, N.J. This company has been building centrifugal pumps for over two decades, most of them being used, however, in connection with condensers. The new line of pumps is suited for all services.

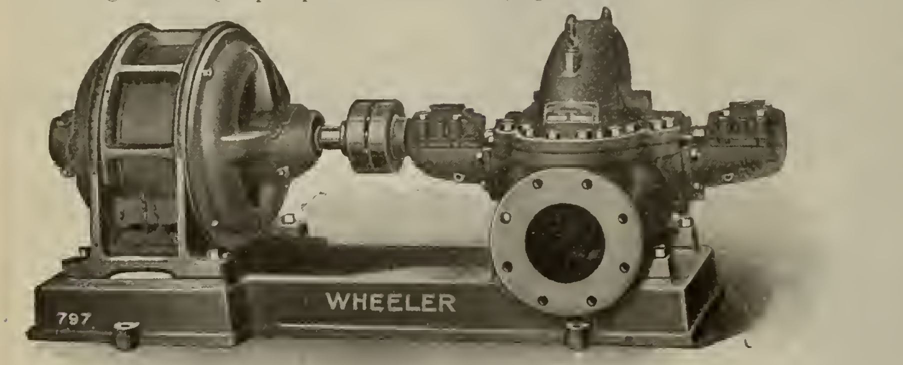


FIG. 1. TYPICAL SMALL MOTOR-DRIVEN PUMP FOR TANK OR STAND PIPE SERVICE. CAPACITY 1000 GALLONS PER MINUTE.

A small motor-driven unit for tank or stand pipe operation is shown in Fig. 1. Referring to the sectional illustration, it will be seen that this pump conforms to the most recent advances in centrifugal pump construction, having a two-part divided casing, with the suction and discharge nozzles in the lower half. The impeller is of the closed double suction type, protected by labyrinth wearing rings. The shaft is protected from the water by bronze sleeves, which screw on to the shaft and extend clear through into the bearing bracket boxes Bearings are of the ring-oiled type, and in the outboard bracket, there is located a ring-oiled thrust bearing. A feature of these pumps is the large size of the bearing brackets and the fact that they are bolted to the pump casing, instead of being cast integral with them.

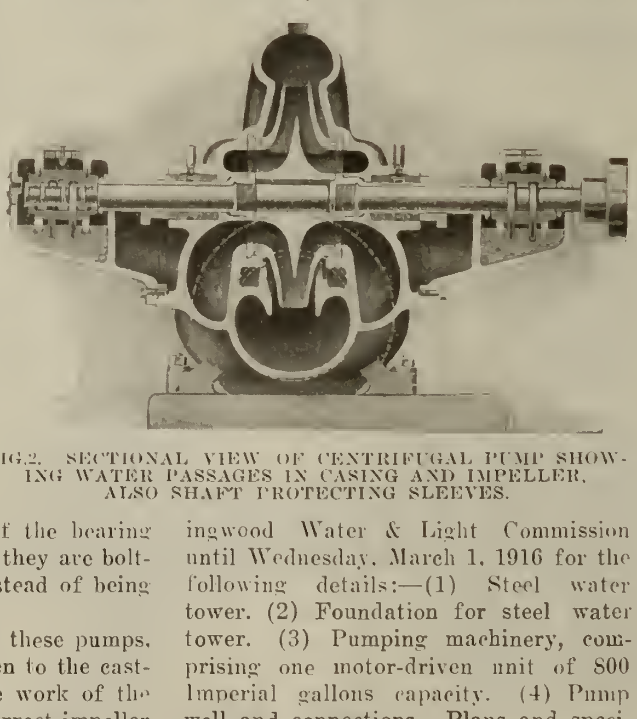


FIG. 2. SECTIONAL VIEW OF CENTRIFUGAL PUMP SHOWING WATER PASSAGES IN CASING AND IMPELLER, ALSO SHAFT PROTECTING SLEEVES.

In the manufacture of these pumps, particular attention is given to the casting of impellers, since the work of the designer in selecting the correct impeller dimensions may be entirely defeated by crude or careless shop work. The impellers are cast in dry sand or skin dry molds, and the cores are made from a core "sand" resembling a fine powder, which when properly mixed, weathered and baked into a core, gives a surface to which the metal adheres perfectly, giving a finished impeller casting true to pattern.

*

Trade Gossip

E. Laurie, of the E. Laurie Co., Montreal, agents of the DeLaval Steam Turbine Co., is now in England, having joined the Aviation Corps there.

The Main Belting Co. have reopened their office at 32 Front Street, Toronto, where they will carry a full line of all sizes of their belting to ensure prompt delivery. S. R. Walsh will be local manager.

Collingwood, Ont. — Tenders will be received by the chairman of the Collingwood Water & Light Commission until Wednesday, March 1, 1916 for the following details:—(1) Steel water tower. (2) Foundation for steel water tower. (3) Pumping machinery, comprising one motor-driven unit of 800 Imperial gallons capacity. (4) Pump well and connections. Plans and specifications may be seen at the office of the Engineers Chipman and Power, 204 Mail Building, Toronto, or at the Water and Light Office, Collingwood.

Hamilton, Ont.—Tenders will be received up to Wednesday, March 1, 1916, for supplying the corporation of the City of Hamilton, with the following:—Castings (ordinary and special), iron pipe, hydrants, valves, extension boxes, lead pipe, pig lead, rubber hose, rubber boots, road oil, lubricating oil, flux, fuel oil, coal oil, gasoline, concrete and garbage duck covers, bass brooms, sectional sweepers, brass work, including ordinary and special brass castings for water department, hardware. Specifications and form of tender for all of the above can be obtained at the office of the city engineer, Hamilton, Ont.

Catalogues

The Cling-Surface Co., of Buffalo, N.Y., have issued a special calendar of interest to engineers, and as long as the supply lasts will gladly send a copy to any engineer who applies to them for one.

Condensers.—The York Manufacturing Co., York, Pa., have issued a leaflet illustrating and describing the "York" flooded ammonia condenser for refrigeration plants. Copies of the leaflet may be obtained from The Canadian Ice Machine Co., Toronto.

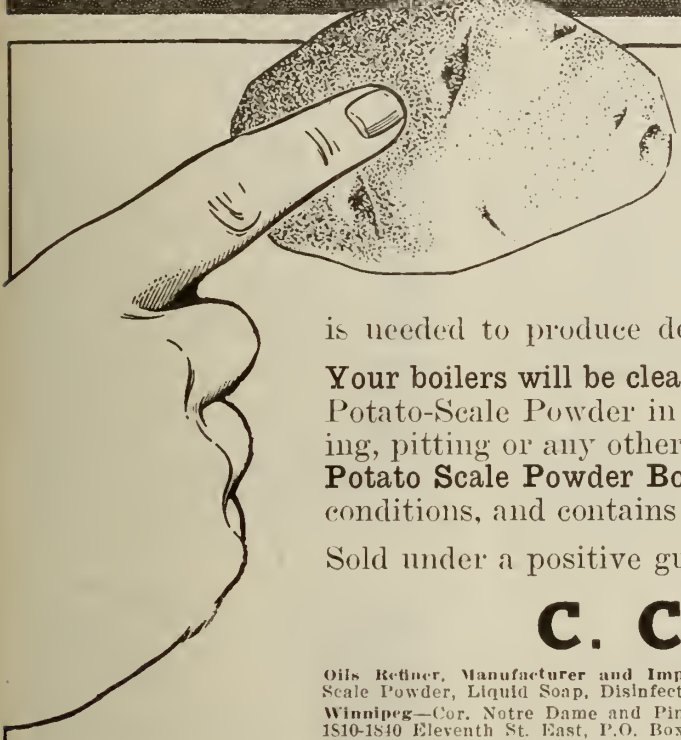
McKim Gaskets, is the title of Catalogue No. 16, issued by the McCord Mfg. Co., Detroit, Mich. The essential features of the McKim copper asbestos gaskets are described fully and dimensions and prices given for the various sizes The wide range of service is dealt with accompanied by illustrations showing a variety of joints where the gaskets are used.

Graphite Products. — The Joseph Dixon Crucible Co., Jersey City, N.J., are distributing a booklet entitled "Valuable Graphite Products," which deals with the company's well known and extensive line of graphite products. The class of work for which each product is intended is stated and its principal features dealt with fully. Price lists are included for the various lines.

F. Reddaway & Co., of Montreal, have issued a useful pocket diary and memorandum for 1916. Embodied in the diary proper are sectional maps of Canada and the United States. A lot of interesting general information is given in addition to the pages devoted to matter relating to the company's products such as "Camel Hair," and "Black Duck Belting," and "Reddaway" linen fire hose.

Recording Thermometers made by the Bristol Company, Waterbury Conn., are described and illustrated in catalogue No. 120. In addition to the matter dealing with the various types of thermometer are a number of specimen sections of the different sizes of charts for use

Potato Scale Powder Boiler Cleanser



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Your boilers will be clean all the time if you use a small quantity of Potato-Scale Powder in your feed water daily—there will be no foaming, pitting or any other troubles due to impurities in the feed water. **Potato Scale Powder Boiler Cleanser** is made to suit your feed water conditions, and contains nothing injurious to tubes or fittings.

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It's the cartridge of a fuse that costs—why discard it when the inexpensive refill blows?

Two minutes time and a renewal element makes a new fuse of the blown

Monarch Refillable

MONARCH REFILLABLE FUSE
A Sure Contact

Monarch Refillable Fuses cost but little more than the ordinary kind—the renewals a mere trifle.

Illustration shows Knife Blade Type with one end cut away to disclose the method of forming the contact between the fuse ribbon and the blade.

The Monarch Refillable Fuse is constructed with all parts Die Stamped, making the parts accurate and interchangeable, thereby making the *refilling very simple,* as the different parts will fit either cap. Our *Spring Gripping* contacts are made of copper, assuring proper carrying capacity and cooling surface.

When you buy Monarch Refillable fuses you get *efficiency, reasonable price* and *prompt shipment.*

WRITE FOR CIRCULAR GIVING FULL DESCRIPTION.

Dealers and Agents in open territory will find it worth their while to investigate our proposition.

The Monarch Refillable Fuse Co.
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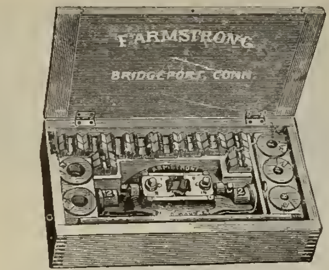

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PIPE VISES, PIPE CUTTERS,
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MANUFACTURED BY
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ENGINES.
75 H.P., 16 x 36 Leonard Corliss, used less than year; heavy duty type.
85 H.P., 13 x 30 Brown automatic, excellent condition.
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BOILERS.
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GENERATORS AND MOTORS.
200—300-light dynamos.
20, 25, 35, 250-volt motors.
50 H.P. gas engine and producer, good as new, at great bargain.
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Works Equally Well on Hot and Cold Surfaces. It Cannot Blow Up. Cleans, Polishes and Preserves all kinds of metals.

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with the thermometers. The catalogue also describes different styles of connecting tubes for various purposes and contains in the same section price lists for the various recording thermometers described in the preceding pages. A partial list of users of the "Bristol" recording thermometers is included.

Steam Traps.—The George W. Cole Co., Toronto, Ont., have issued a new booklet illustrating and describing their line of boiler feed, return feed, lifting and vacuum traps. The illustrations include a diagram of a double trap installation. A table shows fuel losses when using steam pumps instead of return traps while other items include a price list, particulars of the "Cole" oil separator and a list of users of the "Cole" trap. Copies of this booklet may be had on application.

Air Compressors. — The "Zin-Ho" portable and semi-portable air compressors made by the Zin-Ho Mfg. Co., Chicago, Ill., are described and illustrated in bulletin No. B5. The portable outfits are first dealt with, the description covering the principal features and a table gives the general dimensions etc. The semi-portable outfits include air compressors, electric lighting plants and pumping outfits. each type being illustrated and briefly described. The "Zin-Ho" portable crane for shops and shipping rooms is also illustrated and described.

Mechanical Rubber Goods made by the Quaker City Rubber Co., Philadelphia, Pa. An interesting and extensive line of mechanical rubber goods including belting, hose for a large variety of purposes, sheet and rod packings, gaskets, valves and tires etc., are described and illustrated in this catalogue. Many of the illustrations are colored giving the catalogue a highly attractive appearance. Several useful tables on belt transmission and pulley diameters are included and the concluding page contains a telegraph cipher code and index.

Psychrometric Tables for Cooling Tower Work published by the Wheeler Condenser & Engineering Co., Cartaret, N.J. This is a companion book to "Steam Tables for Condenser Work" and consists of a handbook of tables giving dry and wet bulb thermometer readings, dew point, humidity and the pounds of water vapor per thousand cubic feet and per hundred pounds of air, together with a discussion of Psychrometry and the use of the sling psychrometer. The tables were read from an alignment chart specially prepared for the company.

Testing Machines.—Catalogue No 93 superseding No. 76 deals with the Sturke-Watson-Stillman testing machine for cylindrical gas containers. The apparatus and methods of testing cylinders are described in a comprehensive manner followed by a detailed description of the Sturke-Watson-Stillman testing machine with full directions for tests with the results obtained, accompanied by curves and tables. Copies of this catalogue may be obtained from the Watson-Stillman Co., Aldene, Union County, N.J.

Threading Machinery. — The Landis Machine Co., Waynesboro, Pa., have issued a catalogue No. 22 covering an interesting line of threading machinery for bolts, pipes and nipples, etc., also cutting machines, screw cutting die heads and chaser grinders. The opening pages deal fully with the Landis chaser, chaser holder and rotary die head which are carefully illustrated and their mechanism described. Diagrams and specifications are included in this section. Several different styles of bolt cutters are shown with a specification for each while bolt pointers are treated in the same way. The succeeding pages deal with the pipe and nipple threading machines and chaser grinders specifications being included in all cases. The concluding pages contain a telegraph code for all the lines and accessories, and also some useful mechanical tables on cutting speeds and threads.

Ball Bearings. — The Norma Co., of America, New York, have issued a catalogue No. 105 just off the press dealing with the "Norma" precision bearings. The catalogue contains 123 pages and endeavor has been made to present the subject in a way that will be interesting and helpful to engineers and also of some permanent text book value. The first 18 pages contain all the essential facts about "Norma" roller and ball bearings covering the principal features embodied in their construction. The succeeding 20 pages deal with the principles of anti-friction efficiency as applied to "Norma" bearings covering the various types and explaining the facts in relation to bearing principles. Following the text matter comes 60 pages of tabular data giving the principal dimensions of the various types accompanied by diagrams and revealing the wide scope of the "Norma" line of bearings. Pages 102 to 115 contain a large variety of application drawings as suggestions for the draughtsman engineer while the concluding pages contain notes and suggestions on the selection of anti-friction bearings.

Nonpareil Corkboard Insulation, is the title of a catalogue being issued by the Armstrong Cork & Insulation Co., Ltd., Montreal, Que. The catalogue deals with the production and application of cork for insulating purposes and contains a great deal of interesting information of both a practical and scientific value. A number of pages deal with the heat conductivity of "Nonpareil" corkboard and other insulating materials and also includes reports on tests of these materials. The fire-resisting properties of "Nonpareil" corkboard are described, accompanied by illustrations, showing fire tests and a number of installations of this material. Several specifications for erection covering various types of building are included with sectional diagrams showing the corkboard construction. The concluding pages deal with miscellaneous uses for "Nonpareil" corkboard, illustrated. This is a high class catalogue containing a considerable amount of useful information for refrigeration engineers. The press work is good and the illustrations are very clear. Copies will be sent to interested readers on application.

Centrifugal Pumps for all purposes, including condenser circulation, irrigation, drainage, dry docks, and general mill and power plant service, for motor, engine or belt drive, are now being built by the Wheeler Condenser & Engineering Co., of Carteret, N.J., and are described in their new bulletin 108—A. These pumps are of the single-stage, double-suction, split-casing type, for heads from 0 to 300 feet. Particular stress is laid in this bulletin on the adequate testing facilities in the Wheeler hydraulic laboratory, provided with calibrated motors, gauges and tanks with V-notch and rectangular weirs for measuring the quantity of water, and secondly, up the accurate casting and machining of pump parts, particularly the impellers. A short description of foundry methods is given. Among the designs of pumps shown, several are of particular interest, such as, a combined motor and geared turbine-driven centrifugal pump, a typical complete surface condenser auxiliary, with geared circulating pump direct connected to turbo air and condensate pump driven from a common turbine, a large vertical shaft dry dock pump, etc. Several pages are devoted to vertical shaft pumps, and excellent illustrations show the design of the vertical thrust bearing with self-contained lubricating oil pump, of the lower self-lubricating guide bearing, and the design of impeller and casing.

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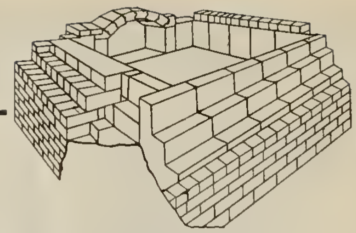

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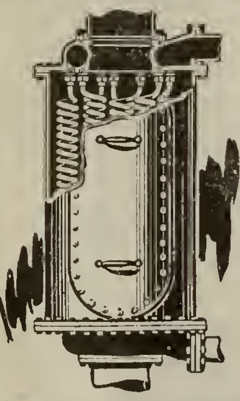

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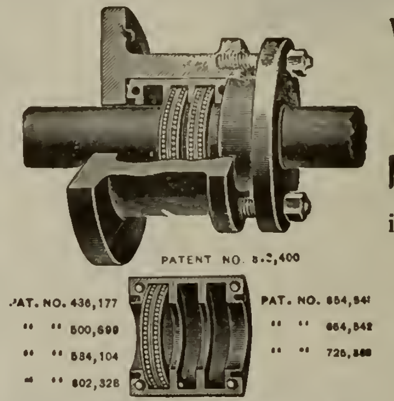

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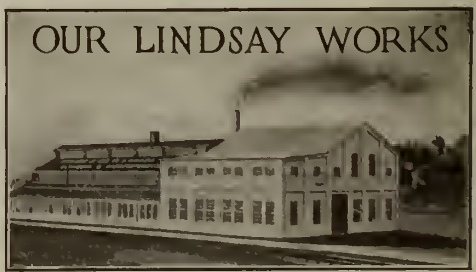

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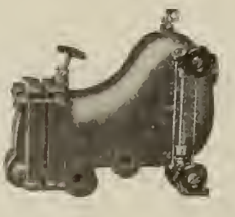

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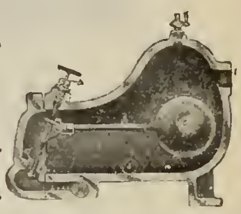

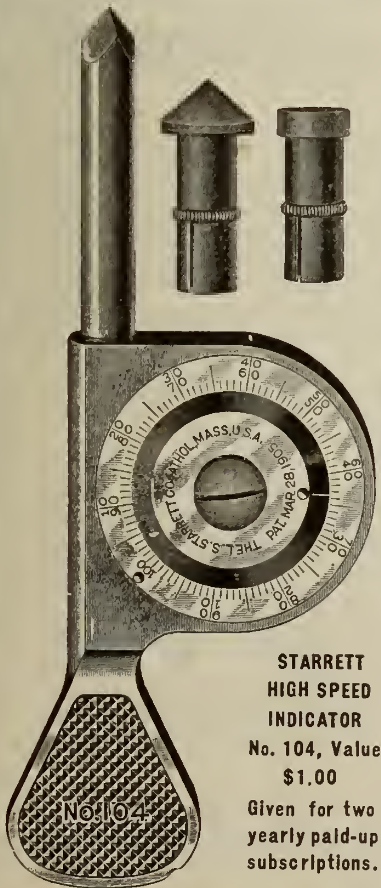

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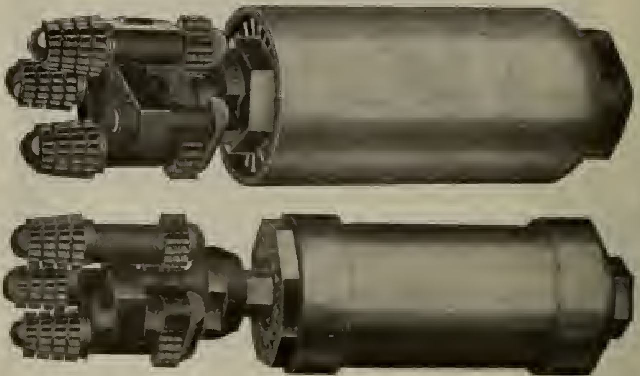

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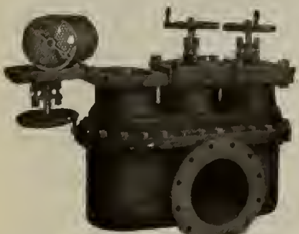

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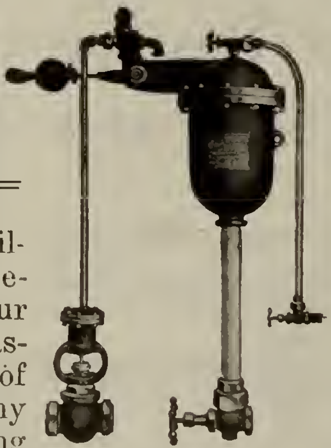

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Wheeler Condenser & Engineering Co., Carteret, N.J.

Cooler Doors.
Jamison Cold Storage Door Co., Hagerstown, Md.

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Can. H. W. Johns-Manville Co., Ltd., Toronto.

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Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia.

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Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

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Wm. Hamilton Company, Ltd., Peterborough, Ont.
Jeffrey Manufacturing Co., Montreal.

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Smart-Turner Machine Co., Hamilton, Ont.

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Babcock & Wilcox, Ltd., Montreal.
Smart-Turner Machine Co., Ltd.,

Cranes, Hand Power.
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Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Smart-Turner Machine Co., Hamilton, Ont.

Cranes, Overhead Travelling.
Babcock & Wilcox, Ltd., Montreal.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Smart-Turner Machine Co., Hamilton, Ont.

Cranes, Post Jib.
Babcock & Wilcox, Ltd., Montreal.

Cranes, Swing Jib.
Babcock & Wilcox, Ltd., Montreal.

Cranes, Wall.
Babcock & Wilcox, Ltd., Montreal.

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Lunkenheimer Co., Cincinnati, O.

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Graton & Knight Mfg. Co., Montreal.

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Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
C. A. Dunham Co., Ltd., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Mason Regulator Co., Boston, Mase.
Jas. Morrison Brass Mfg. Co., Toronto.
Geo. H. Tod, Toronto.

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Borden Canadian Co., Toronto.
Oster Mfg. Co., Cleveland, O.

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Graton & Knight Mfg. Co., Montreal.

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Frick Co., Waynesboro, Franklin Co., Pa.

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Frick Co., Waynesboro, Franklin Co., Pa.

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Dynamos.
Canadian Fairbanks-Morse Co., Ltd., Montreal.

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Terry Steam Turbine Co., Hartford, Conn.

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Jas. Morrison Brass Mfg. Co., Toronto.

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Waterous Engine Works Co., Brantford.

Engines, Corliss and Rocking Valve.
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Jenckes Machine Co., Sherbrooke, Que.
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Laurie & Lamb, Montreal.
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Belliss & Morcom, Birmingham, Eng.
Canadian Griscom-Russell Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
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Canadian Fairbanks Morse Co. Ltd., Montreal.
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Engines, Saw Mill.
Goldie & McCulloch Co., Galt.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
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MacLean Publishing Co., Toronto.

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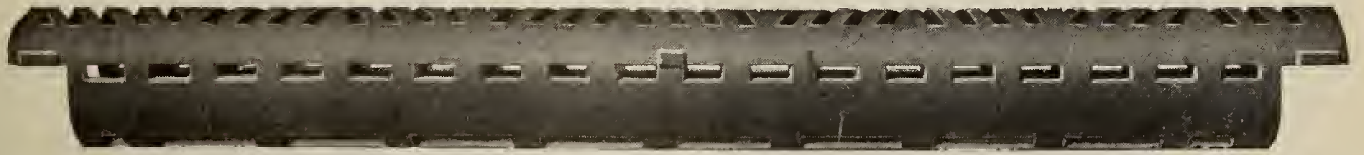

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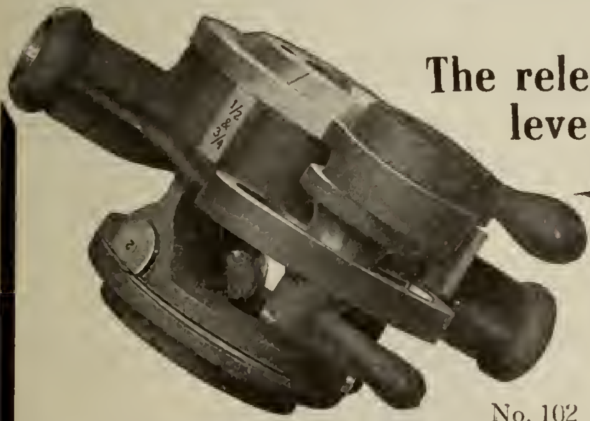

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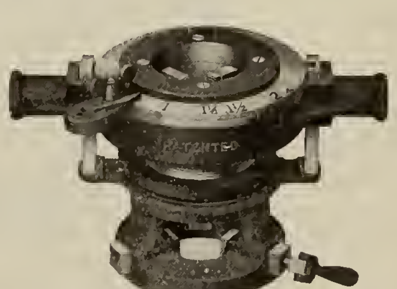

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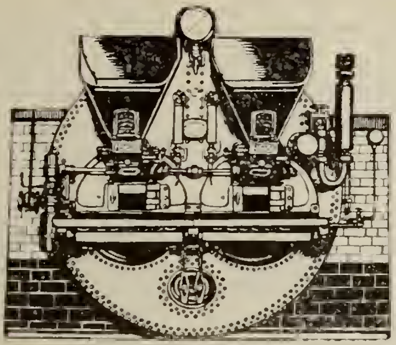

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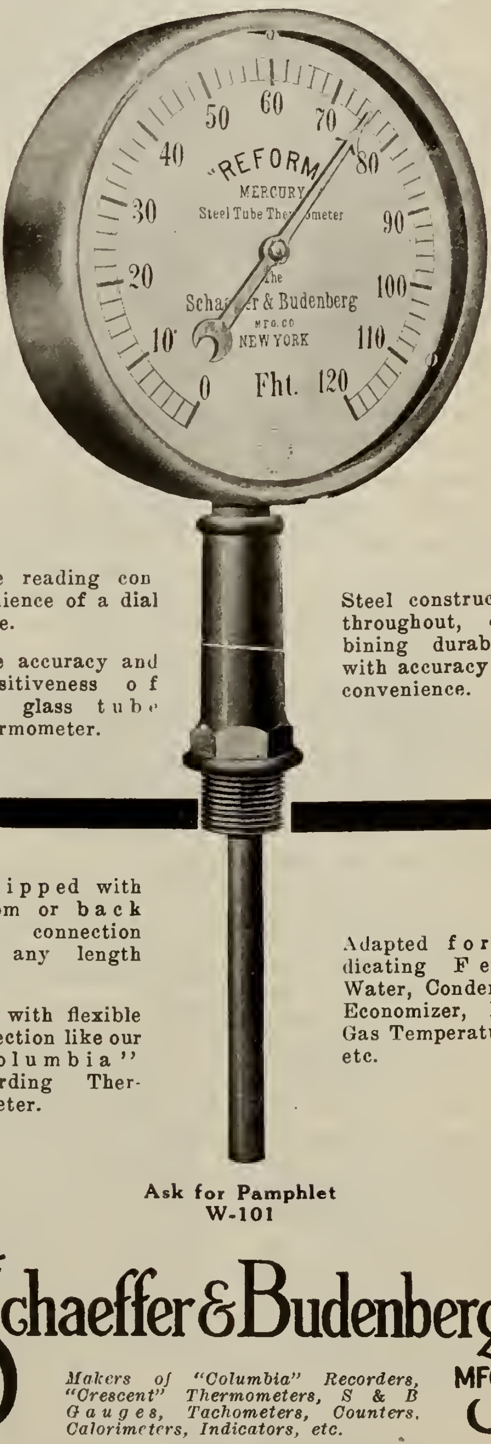

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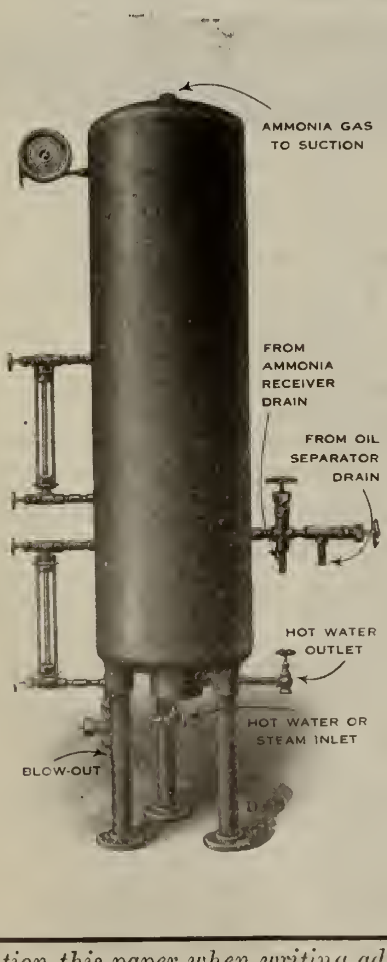

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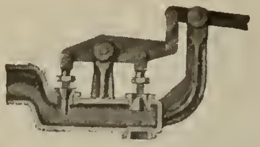

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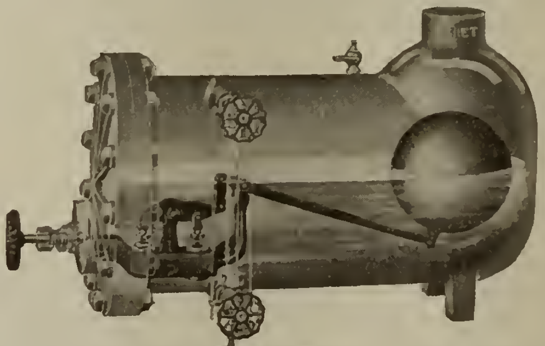
Nearly forty years on the market and not an important change has been made in the design. Try a Davis trap at our risk. The price is reasonable and you will not have to buy it unless you are fully satisfied.

Send for Booklet

Let us send you a 15-page booklet that tells all about the trap and explain in detail about our "try before you buy" plan of selling.

G. M. Davis Regulator Co.
434 Milwaukee Ave., Chicago
Valve Specialty Manufacturers Since 1875



Two valves instead of only one gives large capacity

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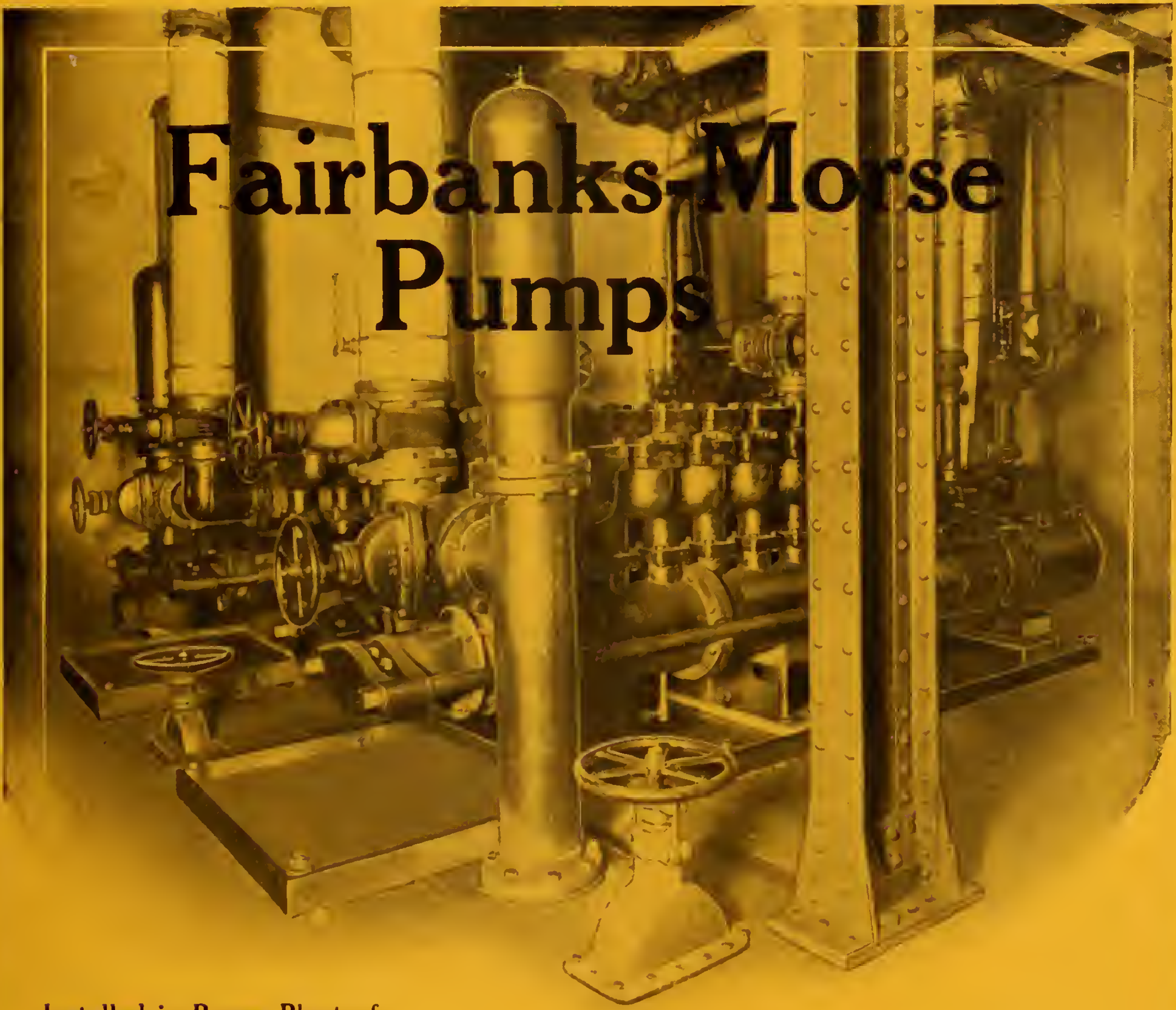
Fairbanks-Morse Pumps



Installed in Power Plant of Montreal Tramways.

Still in Use after 14 Years Continuous Service

These Pumps form a battery of two—16" x 8" x 18", and are used for feeding the boilers against a pressure of 175 to 250 lbs. The Valve pots are interchangeable. The four single acting plungers are connected by steel side rods and crossheads. The stuffing boxes are outside and easily adjusted or packed.

Fairbanks-Morse Valve pot pumps are made in many sizes and capacities for pressures up to 10,000 lbs. per sq. inch. There is a Fairbanks-Morse Pump for every service. If it is Pump Service you want, let a Fairbanks-Morse pump do your work.

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Canada's Departmental House for Mechanical Goods.

CFM

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Calgary, Edmonton, Vancouver, Victoria

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MORRISON'S APPROVED GAUGE REGISTERED ONT 208 SASK 3260 ALTA 781
THE JAS MORRISON BRASS MFG CO LTD TORONTO
SINGLE SPRING

On a Grand Trunk Engine 32 YEARS

Away back in December, 1882, we sold our steam gauge, No. 12388, to the Grand Trunk Railway. Now, in June, 1914, the Grand Trunk sends No. 12388 back to us for repairs! Repairs that will cost about $1.50, and to the best of our knowledge will send this honorable old gauge on to its job again for another thirty-two years.

We're proud of No. 12388. It proves our claim that we make the honest, long wearing kind of goods—proves it up to the hilt in the only way that is final.

So much for the past.

At present we are making, if possible, better gauges than ever—gauges for every purpose. And as we would have to buy the whole magazine to tell you about all their good points, you had better let us write you direct about the line in which you are interested. As business people you will find us as good as the products we manufacture, and that IS good.

ONLY MAKERS OF GAUGES IN CANADA.
MAKERS OF AS GOOD GAUGES AS CAN BE BOUGHT.

The James Morrison Brass Manufacturing Co.
LIMITED
93-97 Adelaide St. W. TORONTO

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.
MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-153 University Ave. LONDON, ENG.: 88 Fleet St., E.C. WINNIPEG: 34 Royal Bank Bldg.

Vol. IX Publication Office, Toronto—March, 1916 No. 3

FILE COPY

PENBERTHY

POLAR

STEAM LUBRICATOR

THE NEW COLD WEATHER CUP

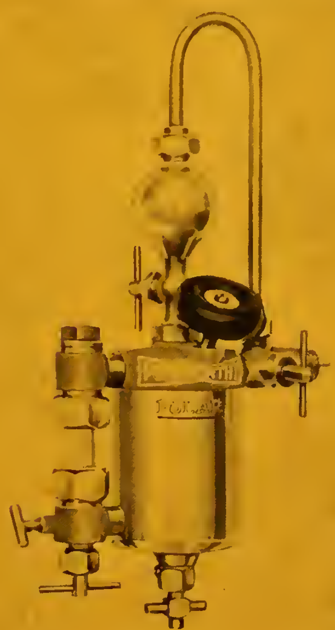
Equipped with Special Heating Chamber. Oil Always in Liquid Condition.

Double Connection

POLAR

Lubricators are designed along the same high-grade lines as the most expensive cups, and are equipped with a long-sight feed glass which shows the engineer at a glance the exact amount of oil being fed to the engine.

On account of the special heating chamber located in the oil reservoir, they make an ideal outdoor lubricator in cold weather.



Single Connection

For a General Purpose Lubricator They Have No Equal

Manufactured by

PENBERTHY INJECTOR CO., Limited, WINDSOR, ONT.

We Build:

WATER TUBE BOILERS like this

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HORIZONTAL
RETURN TUBULAR
BOILERS
Standard or Special like this

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And ALL KINDS OF TANKS like this

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Also all kinds of Marine Boilers, Land Boilers, Plate Work, etc.

Send us your specifications and blue prints.

POLSON IRON WORKS, LIMITED
SHIPBUILDERS, ENGINEERS AND BOILER MAKERS
TORONTO, ONTARIO

Waterous Boilers

Clean-cut construction and honest workmanship distinguish these boilers. They are built for both power and heating purposes—better than required by law.

Horizontal Return Tubular Boilers—25 to 165 H.P.
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Vertical Boilers—6 to 25 H.P.
Special and Marine Boilers—all sizes.

If you appreciate economy, convenience and safety in your boiler room, let your next boiler be "Waterous built." Our new catalogue, just from the printers, is at your service.

Catalogue No. 506—Ask for it.

THE WATEROUS ENGINE WORKS CO., LIMITED
Brantford, Canada

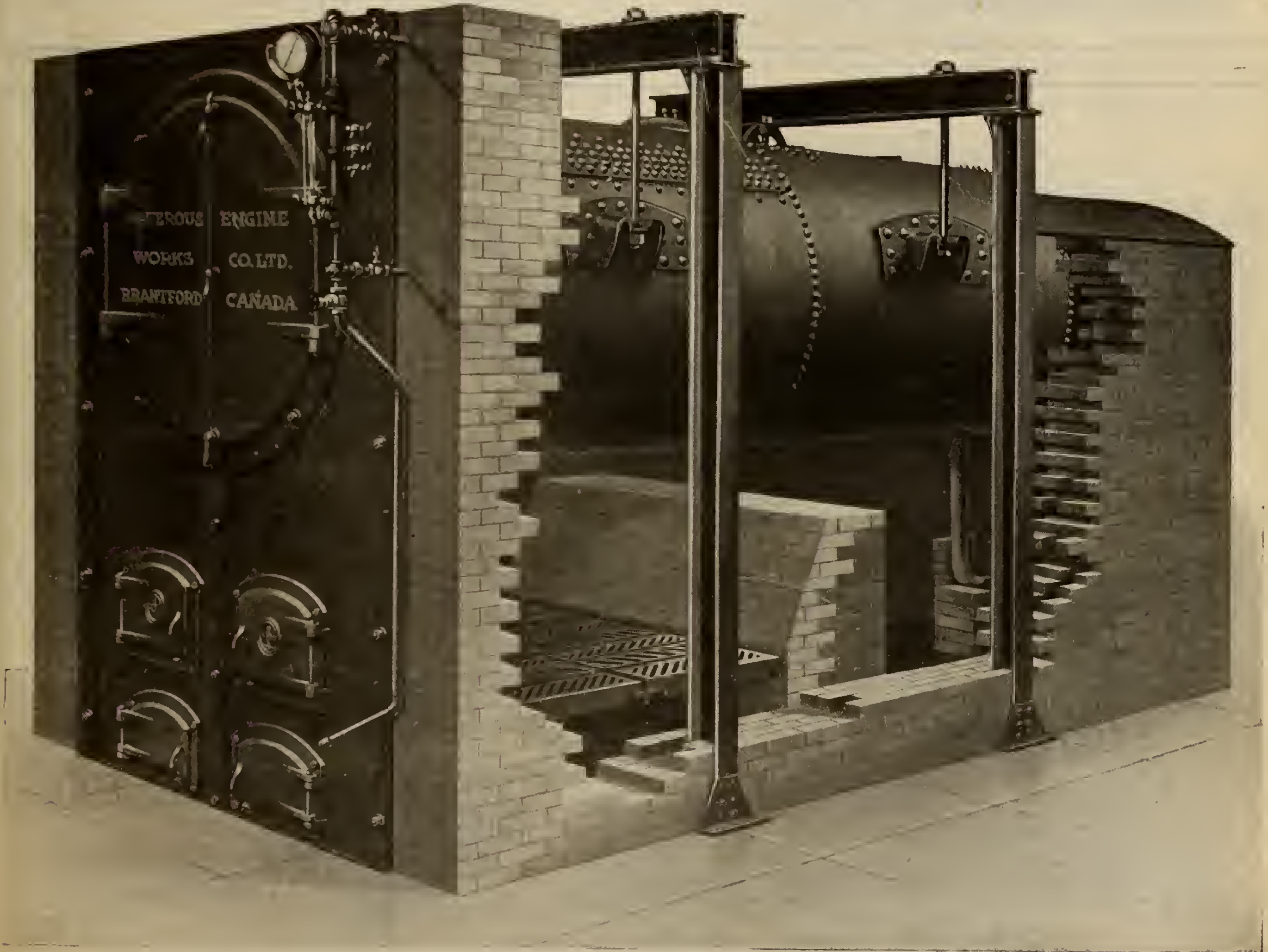
Save Fuel and Labor

Waterous Boiler settings are designed to best utilize the fuel at your disposal.

Whether you are burning coal of the highest quality, or screenings, wood or sawdust, we build settings in brick or steel, that will burn it with the least labor and with the best economy.

A properly designed setting is essential to a good boiler.

We can give you both.



7 POINTS to ponder in selecting RADIATOR STEAM TRAPS for your Heating System.

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7. Should have a reputation, based on past service, of accomplishing these requirements.

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Is especially designed for use in gas engines, gasoline engines, and all classes of marine engines, and is especially adapted for automobile engines.
This alloy is exceedingly tough and durable.

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It will not only take care of high speed, but will stand up to heavy duty in an extra-ordinary way.

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The construction makes for long life, high efficiency and low repairs.

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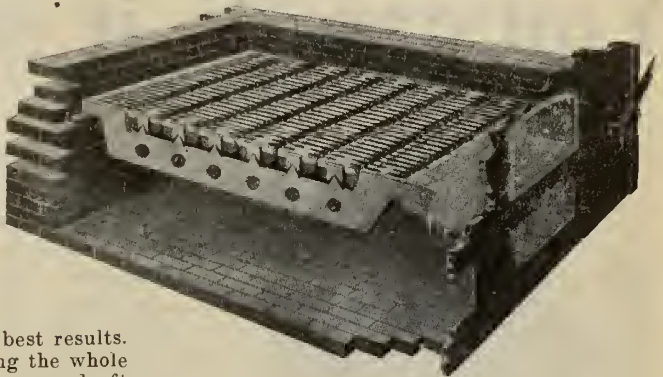
Works : SHERBROOKE, QUE. ST. CATHARINES, ONT.

A sure way of reducing your fuel cost 8 to 20%—

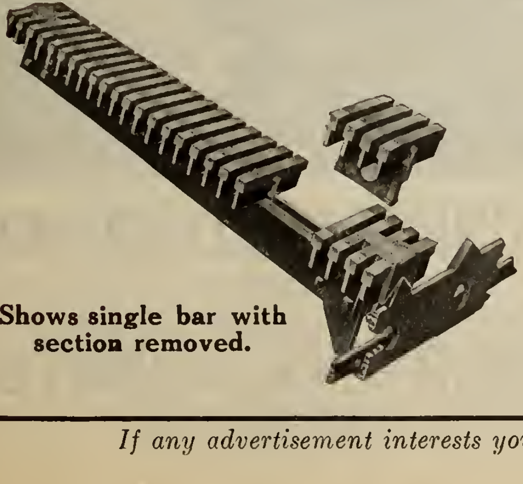


The immense draft area of

The McNaughton Grate

enables you to burn the cheapest quality of fuel with the very best results. The "McNaughton" provides an uninterrupted air gap extending the whole width or length of the furnace. No grate could possibly have more draft area and have any metal support the fuel.

Built for long service as well as for fuel economy



Shows single bar with section removed.

There is room for expansion between each section and no part of the bar is ever under any heat strain. The frame castings are substantial and heavy.

The whole set of grates and framework is self-contained and will fit in where any ordinary grates have been removed. Method of construction makes REPAIRS EASY.

30 DAYS' FREE TRIAL. Installed when convenient to you and without interruption to your plant operations.

It will pay you to take advantage of this offer at once.

Nearly 20,000 H.P. sold during 1915.

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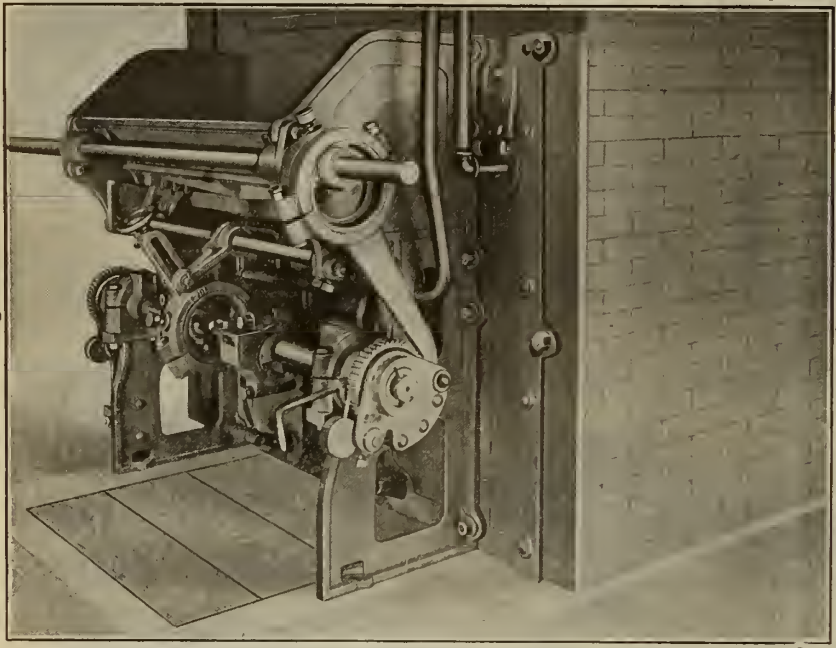

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Lower Fuel Costs by Installing the FULTON STOKER

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The above aggregate 3,010 H.P.

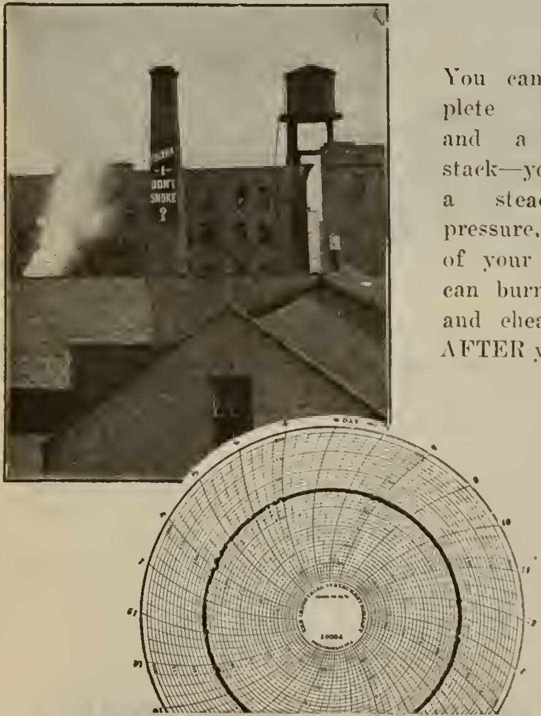
Send for Bulletin F-106 P—a postcard will bring it.

Made in Canada
15,000 h.p. in use

Sales Agencies: Montreal, Port Arthur, Winnipeg, Calgary, Edmonton, Vancouver and Chicago, Ill.

You can do it in Your Plant, too

You can get complete combustion and a smokeless stack—you can get a steady steam pressure, regardless of your loads—you can burn less coal, and cheaper coal—AFTER you install a



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What the Jones Stoker is doing in this plant at London, Ont., and what it is doing in hundreds of other plants, it will do in yours.

JONES UNDERFEED STOKER CO., LIMITED
NATIONAL TRUST BUILDING - TORONTO

Murphy AUTOMATIC Furnace

Prosperity? You Bet!

High-class Industrial Corporations and a Municipality.

"Jes' keep on a keepin' on" placing REPEAT ORDERS for **MURPHY AUTOMATIC SMOKELESS FURNACES.** You should get in the game! We play square!

ONTARIO PAPER COMPANY	Thorold,	Ont.
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2nd order, August, 1914	1 furnace,	330 H.P.
3rd order, February, 1916	2 furnaces,	666 H.P.
	7 furnaces,	2328 H.P.
BEAVER FIBRE BOARD CO., LTD.	Thorold,	Ont.
1st order, May, 1913	2 furnaces,	600 H.P.
2nd order, February, 1916	1 furnace,	300 H.P.
	3 furnaces,	900 H.P.
HAMILTON CITY HOSPITAL	Hamilton,	Ont.
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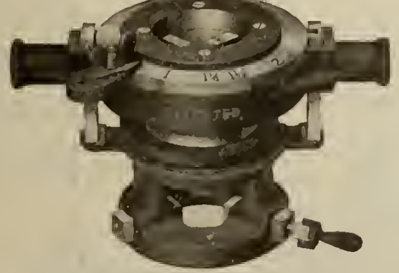

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Cut right or left hand thread. Sizes 1/8 to 8 inches diameter.

"BEAVER SQUARE END PIPE CUTTERS"

Will cut pipe 1/8 to 6 inches diameter.

Booklet and Prices on request.

WRITE NOW.

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ED. BENNIS & CO., Ltd.
28, VICTORIA ST., S.W.

Works: Little Hulton, Bolton.

To all our Friends and Customers.

Dear Sirs:

We desire to express our regret that for some months past it has not been possible for us to give your orders that undivided attention which we have hitherto been accustomed to give.

The overwhelming pressure of Government work is the sole cause of this apparent remissness. All our energies have been concentrated on fulfilling with the utmost possible speed the large number of contracts with which we have been favored for the erection of Automatic Stokers, Coal Bunkers, Conveyors, Elevators, and Storage Plant for National Munition Factories and other Government works.

Our chief difficulties have now, we think, been overcome, and the recent extensions to our Works at Little Hulton and the improvements effected in our organization justify us in thinking that we shall shortly be able to fill satisfactorily all requirements.

At the same time, we would strongly urge upon our friends the desirability of so far anticipating their wants as to send us their enquiries as soon as possible rather than wait until the need has become urgent.

If this is done, we, on our part, will faithfully endeavor to carry out our obligation and (subject, of course, to the National exigencies), to give the best attention and delivery possible.

Yours faithfully,

ED. BENNIS & CO., Ltd.

USED ALL OVER

JENKINS BROS VALVES

RUBBER SPECIALTIES

TRADE JENKINS MARK
Jenkins Bros

THE WORLD

FOR ANY SERVICE

ALSO MECHANICAL

JENKINS BROS' TYPE "K" BRASS GATE VALVES

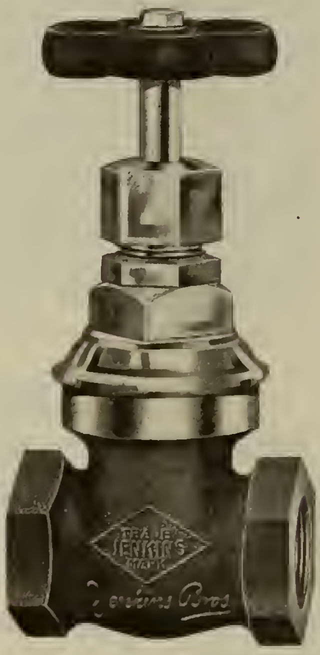

Fig. 300

THESE valves are very carefully designed: the metal is equally distributed, and they have great strength. In the construction of the discs is employed a combination of the solid wedge and the split wedge principles, producing a mechanism which is unequalled for ease of operation and perfect closing. The discs are carried on a spindle-nut, so constructed as to act as a wedge at the point of closing, and at the same time allowing a certain amount of flexibility—permitting the discs to seat perfectly, even should there be a slight derangement of the angle of the seats. Unlike the solid wedge type, the discs cannot jam in the valve body, for the first movement of the spindle loosens the discs, and the guides in the body remove them from the seat faces.

Jenkins Bros.' Type "K" Brass Gate Valves have been registered for use in Ontario and the Western Provinces by the Departments of Public Works.

Stocked by dealers everywhere. Catalogue 8 sent free upon request

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103 St. Remi Street **MONTREAL**

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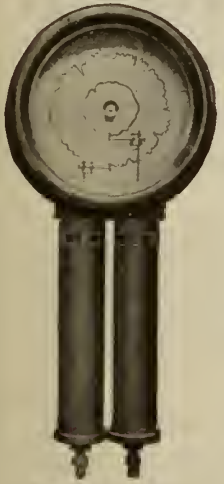
TRADE JENKINS MARK
Jenkins Bros

MONTREAL CAN.

UEHLING WASTE METER

COMBINED CO_2 AND TEMPERATURE RECORDER



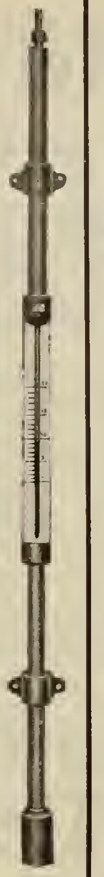
Record of CO2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The Uehling CO_2 Recorder makes a complete 24 hr. record of your combustion efficiency and the CO2 indicator at the Boiler Front holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.



CO2 Indicator for Boiler Front

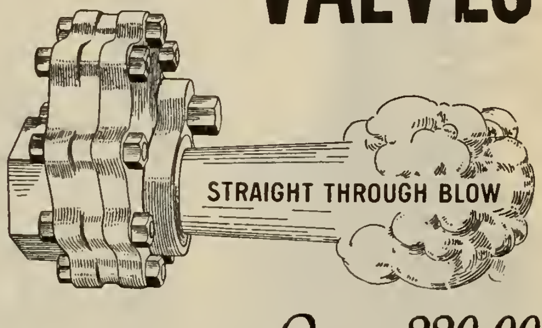
Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company
2008 Empire Building New York City

EVERLASTING

Blow-Off VALVES



"EVERLASTING" Blow-Off Valves will immediately end your blow-off leaks or troubles.

No Packing.

No Stuffing Box.

Self-Grinding Seat.

Self-Cleaning.

—NOTHING TO GET OUT OF ORDER.

Over 220,000 in use

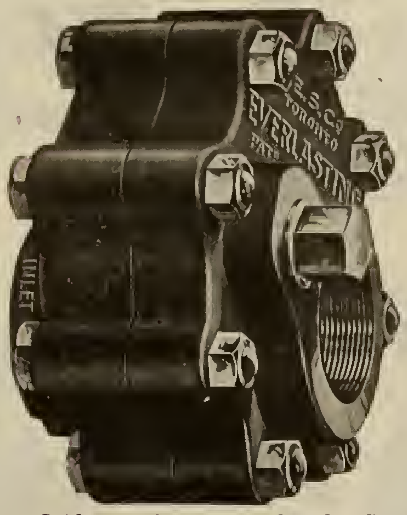
The *Everlasting Valve*—endorsed by leading Consulting Stationary and Marine Engineers.

Accepted by Boiler Inspection Insurance Companies.

Approved by all Provincial Governments requiring High Pressure Valves and Accessories to be registered and recorded. Provincial Record Numbers furnished on request.

OUR GUARANTEE—Satisfaction guaranteed or money refunded within one year.

Not guaranteed against galvanic action or corrosive acid.



Write for New Catalog No. V-15

Look for this ☚ MARK

The word "EVERLASTING" is on every genuine "EVERLASTING" Blow-Off Valve — it's your safeguard against imitations.

Sold and Manufactured under Canadian Patents by

ENGINEERING SPECIALTIES COMPANY, Limited

1080 King St. West, Toronto

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H. L. Peiler & Co.
VANCOUVER, B.C.
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MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

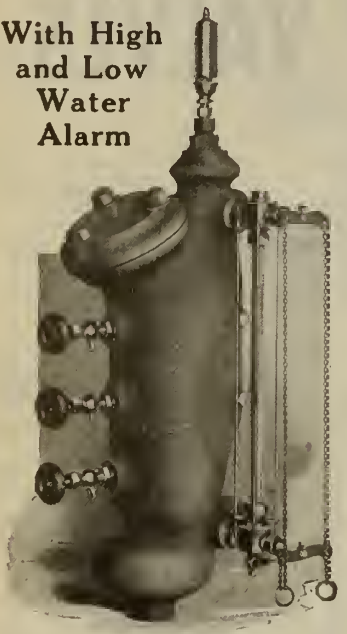
Mason Regulator Company
BOSTON, MASS.
CANADIAN AGENTS
H. L. PEILER & CO., MONTREAL and TORONT

The "Anderson" Safety Water Column

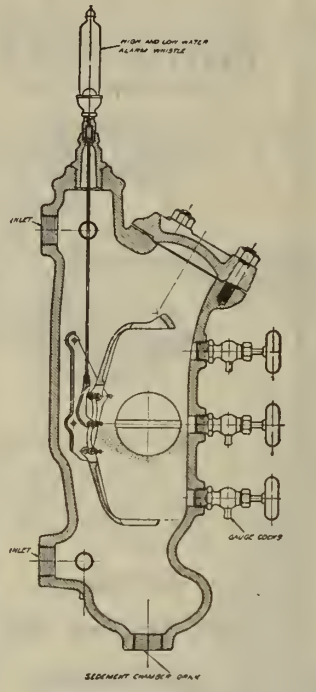
gives the alarm

the instant the water in the boiler falls below or raises above the danger lines.

With High and Low Water Alarm



Exterior



Cross Section

The Anderson Safety Water Column works with greatest reliability and efficiency—the working parts cannot rust or stick.

It is invaluable as a "safety first" device.

The entire mechanism of this Water Column is assembled as a single unit in an independent removable hanger frame hung on accurately machined bronze pivots. Write for full details.

The V. D. Anderson Co.
West 96th St., Cleveland, Ohio

1916 March 1916
SUN MON TUE WED THU FRI SAT

30 Days' Free Trial at Our Expense

So confident are we of the positive and economic service the

American Duplex Return Steam Trap

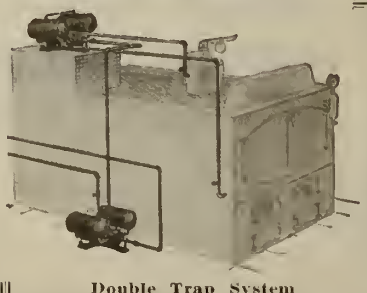
will give you that we will ship on 30 days' free trial—no obligations if we do not prove our claims.

For full details of our free trial offer and special bulletin address

Canadian Duplex Steam Trap Co.
Walkerville, Ont.

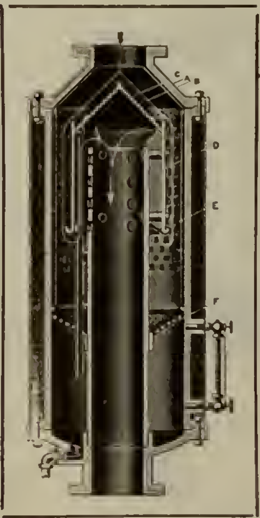
113

A Guaranteed System of Steam Drainage, Water Lift and Boiler Feeding.



Double Trap System

A Unique Feature Of Sweet's Separators



When a drop of water is *once* removed from the steam current by Sweet's Separator, it is *completely* removed, the Separator being so designed that the water never comes into contact with the steam current again.

This is a most important feature and one possessed by no other separator on the market.

It also gives positive separation under all conditions.

Over 7,000 in use at the present time.

Let us send you *full* details. *Write!*

DIRECT SEPARATOR COMPANY
820 South Geddes Street SYRACUSE, N. Y.

General Sales Agents:
Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Vancouver, Victoria.

Built for Service!

Tight seats under maximum pressure, — continuous duty,—absence of trouble,—service which means satisfaction to the user.

LUNKENHEIMER "Victor" Gate Valves

are correctly designed. A solid wedge disc is used, which experience has proven to be the most satisfactory type. The disc has two seating faces, finished to the exact taper of the seat rings. It is guided in the body and travels to practically a closed position before it comes in contact with the seat ring faces.

The seat rings are screwed into the body and can be renewed.

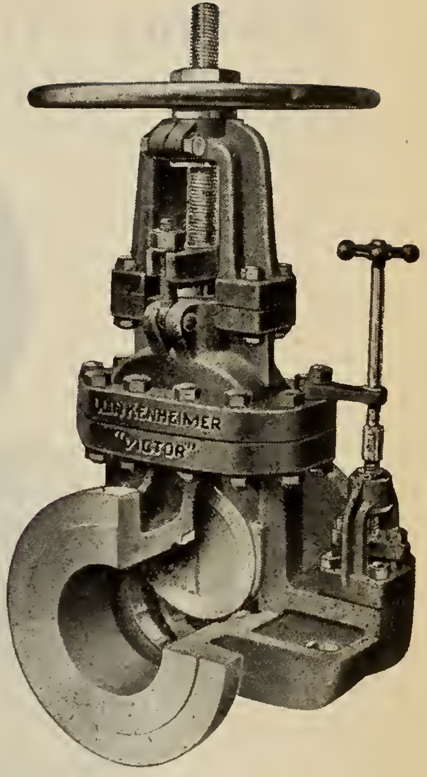
There are no loose parts to wear and cause trouble, and no "dragging" across the seat ring faces when the valve is being opened or closed.

The body is heavy, to resist distortion strains due to expansion and contraction of the pipe line.

The materials used are the highest grade; workmanship is Lunkenheimer "Quality",—a standard unequalled.

Bronze, Cast Iron, "Puddled" Semi-steel and Cast Steel Valves, for working steam pressures up to 350 lbs. Your local dealer can furnish them; if not, write us.

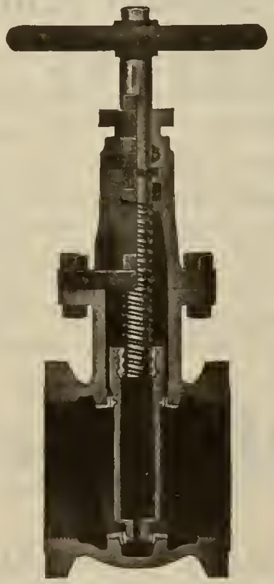
Write for Catalog No. 50



Extra Heavy Pattern with By-pass

THE LUNKENHEIMER CO.
"QUALITY"
Largest Manufacturers of High-Grade Engineering Specialties in the World
CINCINNATI, O., U.S.A.
New York Chicago 6-8-43 Boston London

KERR
("New KEYSTONE" Pattern) GATE VALVES



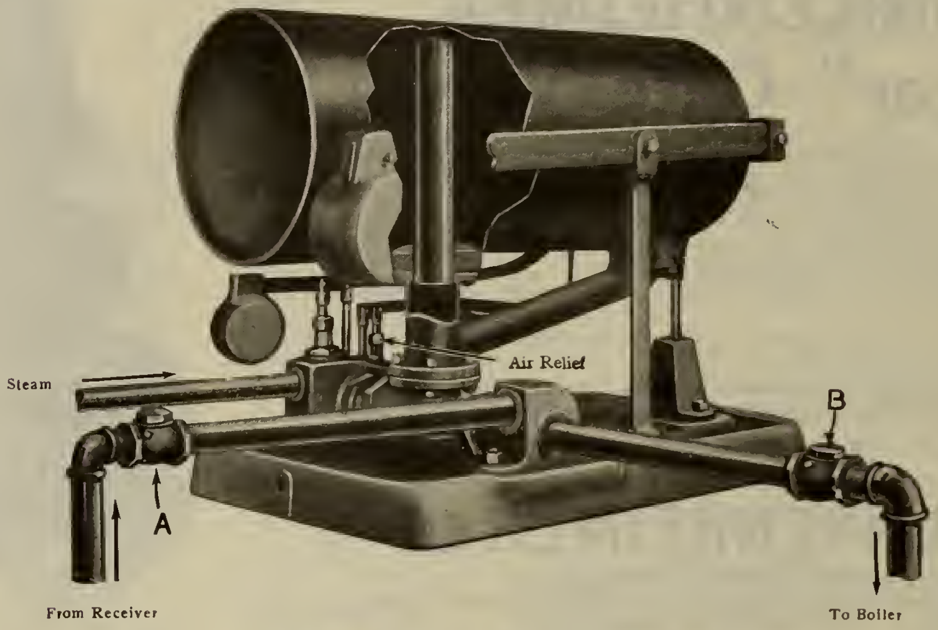
If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

Nothing Mysterious about a Detroit Trap
Every Working Part is on the Outside



"Detroit"
STEAM TRAPS

Some Facts You Should Know About Them

1. Nothing inside the tank to rust, corrode or give trouble—all working parts are on the outside and interchangeable.
2. Large water-handling capacities for space required. Will handle water at a higher temperature than a pump will lift.
3. Properly constructed — properly assembled and thoroughly tested before shipment.
4. Increase efficiency of steam coils or steam-heated machinery by keeping all lines free and clear of condensation.

These are only four of the reasons why "Detroit" Traps save money for the user. Trap catalogue No. 352 gives all information—capacities—sizes, etc. Write the home office or any sales office.

CANADIAN *Sirocco* COMPANY
LIMITED
WINDSOR, ONTARIO.

SALES OFFICES

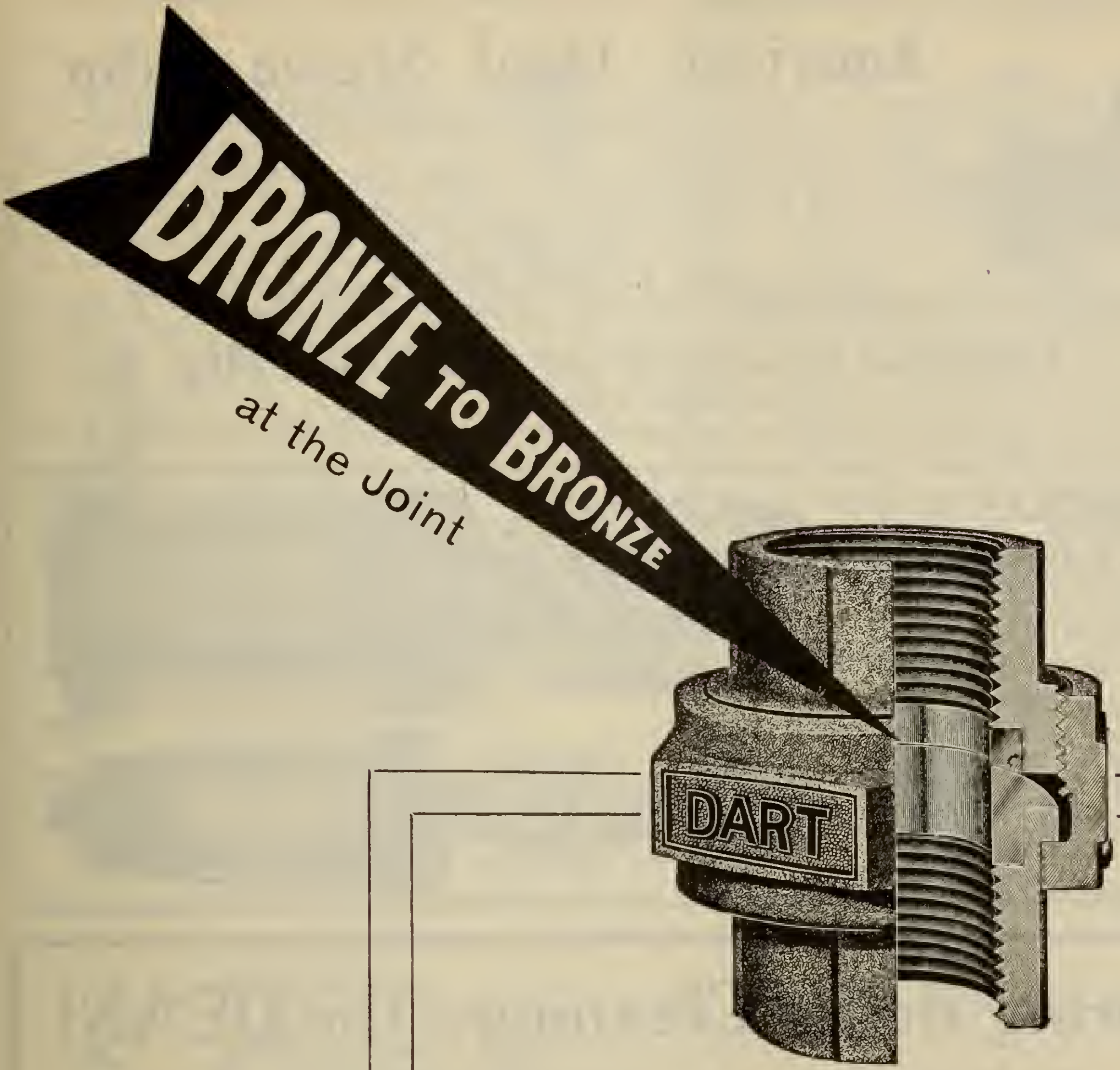
S. S. Clarke,
605 2nd St.,
Calgary.

A. M. Nichol,
301 McGill Bldg.,
Montreal.

W. W. Hicks,
567 Banning St.,
Winnipeg.

Canadian Steam Specialty Sales Co.,
526 Traders Bank Bldg.,
Toronto.
Phone Main 5118

Canadian Sirocco Company, Ltd.,
604 Credit Foncier Bldg.,
Vancouver.



Pipe Joints Never Loosen Up and Leak

When **Dart Unions** are Used

Dart Unions never deteriorate at the joint because both faces are of non-corroding metal.

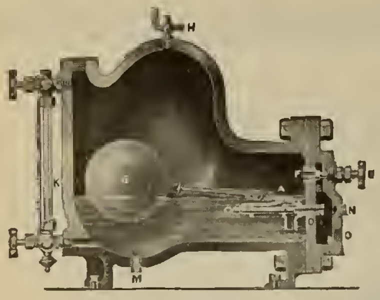
The Heavy Iron Parts make stretching or pulling apart impossible.

The Ball-shaped Joint makes connecting easy, whether pipes are in or out of alignment. A connection that's made with a Dart Union requires no attention, and is insurance against damage by leaks and accidents by blow-outs.

The use of the Dart is real economy.

Sold by all jobbers.

DART UNION COMPANY, LIMITED
TORONTO, CANADA



Sectional View, Ideal Steam Trap

American Ideal Steam Trap

Have you studied the principle involved in Steam Trap operation?
Do you know WHY you ask your dealer for a "One-Inch" or an "Inch" and a "Half" Trap?
Isn't your reason for ordering in that way, "Because I have always done so?"
Is that a GOOD reason?
Why not send for a copy of our booklet, "STEAM TRAP CATECHISM," and become familiar with some facts regarding Steam Traps, which, bought on a Capacity basis—THE IDEAL WAY—SAVE MONEY.

Write our Agents for your copy.

Selling Agents for Canada:

The Canadian Fairbanks-Morse Company, Limited
Montreal Toronto Winnipeg Calgary Saskatoon Vancouver St. John

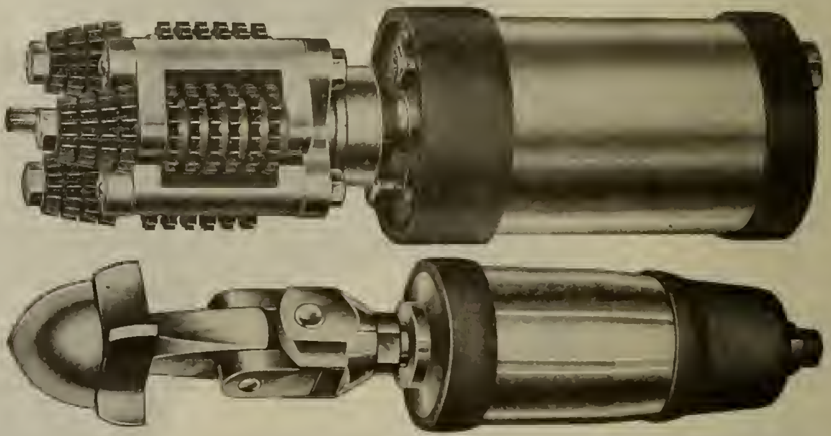
MANUFACTURED SOLELY BY **American Steam Gauge and Valve Mfg. Co.**
Boston, Mass., U.S.A.

ROTO TUBE CLEANERS

Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.
The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.

THE ROTO COMPANY
Write for Catalog HARTFORD, CONN.



For Spring Boiler Cleaning—the DEAN!

You can afford to adopt no halfway methods in ridding your boilers of scale this Spring. Either you'll get ALL of it out—or the end of the season will find the tubes damaged, possibly beyond repair.

If even a small percentage of the scale is allowed to remain on the tubes, they will become greatly overheated, burn out in spots, and put your entire plant in constant danger of a sudden explosion.

In competitive tests, the *Dean Boiler Tube Cleaner* has repeatedly demonstrated its superiority as a scale-remover against every mechanical cleaner made. In many cases, where other cleaners have been "put to it" to get out 100 lbs. of scale from a given number of tubes, the *Dean*, operated through the *same tubes* immediately thereafter, has taken out an additional 100 lbs!

We know this sounds like an exaggeration, but we never make a statement in our advertisements that we cannot prove. We'll gladly show you incontrovertible evidence to prove this.

The *Dean Cleaner* operates equally well in water-tube and fire-tube boilers, may be equipped to take care of several different sizes of tubes, and is the only water-tube cleaner made that removes both soot and scale in one operation.

You may be **absolutely positive** that you have no scale, or that you don't have to clean your boiler tubes this Spring. So were a good many of our friends before they tried out the **Dean**—BUT, when it's made so easy for you to experiment with the Dean and **make sure**—

It's worth the slight effort of trying it out, isn't it?

The **Dean** will tell you more about the presence of scale in or on your boiler tubes than you ever knew before!

Pr. Hse.—Mar. '16

The Wm. B.
Pierce Co.,
Buffalo, N. Y.—or—
Montreal. Que.

Gentlemen: You may send for **Free Trial** one **Dean Boiler Tube Cleaner** to operate in........type of boilers, with tubes measuring ....inches outside diameter. You are to send this Cleaner with the understanding that it will be tried in one boiler, at our convenience, we to pay transportation charges to our plant; if the test is not satisfactory, we may return the Cleaner **at your expense.** There are to be no conditions to this trial offer than the above.

Company ....
Address ...., ...
Person authorizing trial ....
Date ....No. of boilers ....

THE WILLIAM B. PIERCE CO.

152 Ellicott St.
Buffalo, New York

201 Coristine Bldg.
Montreal, Quebec

Winnipeg Representative: W. W. Hicks, 567 Banning St.

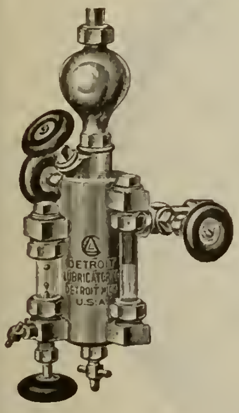
Insist on "Genuine Detroit" Lubricators

Since 1867 the Detroit Lubricator Company has maintained the leadership in the manufacture of an efficient lubricating device for every purpose.

Over half the lubricators in the world are Detroits, and this demand for "Genuine Detroit" Lubricators is the demand for *quality*.

Naturally a product with the reputation of the Detroit has many imitators—some of the imitations being sold on the strength of looking like the Detroit and some as being "just as good as the Detroit."

For your protection we mark every package with the above trade-mark—look for it and see that you get the genuine.



CANADIAN DETROIT LUBRICATOR COMPANY, LTD.

WALKERVILLE, ONT.

Largest manufacturers of lubricating devices in the world

LUBRICATING COMPOUND
ALBANY
EZR
IC

DEPENDABLE LUBRICATION

service of high efficiency and low cost, with every bearing in your plant working cool and easy, is secured with

ALBANY GREASE

Why not let us send you a quantity of Albany Grease, a cup and try it? There will be no charge. Just drop us a card.

Your dealer sells Albany Grease; if not, order direct

Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868

Perolin

The Boiler Metal Treatment

NOW MADE IN CANADA

keeps your boilers new in efficiency and your fuel bills at a minimum.

IT IS NOT A "BOILER COMPOUND" and has no chemical action on either scale or on water. It is purely a metal treatment. Perolin works through the cracks in the scale, which are caused by contraction and expansion of the tubes, to the metal and works along the metal, loosening the scale **mechanically**, so that it can be readily washed out.

When old scale is removed, Perolin forms a preservative film over tubes and shell that prevents scale-forming substances from adhering to the metal. A little Perolin used daily ensures clean boilers.

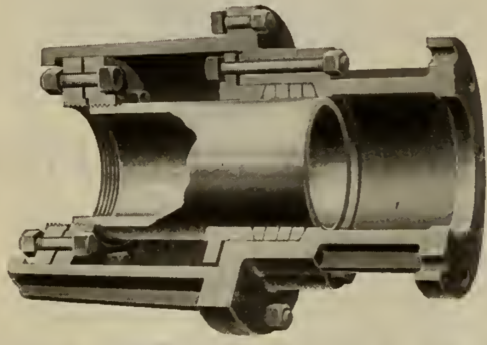
Shipped on sixty days' trial. No cure—no pay.

No better time than now to put it to the test.

PEROLIN COMPANY OF CANADA, Limited

858 Dupont St., TORONTO, Canada

If any advertisement interests you, tear it out now and place with letters to be answered.



Ross Guided Expansion Joint

THE ROSS EXPANSION JOINT consists of the well-known slip joint, with the improvement of a removable guide. This guide eliminates the strain that might be placed on the joint due to sagging of the pipe line, and thereby removes the only reasonable objection there has been to the slip joint type of expansion joint.

THE ROSS EXPANSION JOINT may be repacked, or packing adjusted, without removing it from the pipe line. No special tools are required. On account of the long traverse of the ROSS EXPANSION JOINT, the minimum number are required.

Built in sizes up to 24 in., and for working pressures up to 225 pounds.

MANUFACTURED BY

Alberger Heater Company
BUFFALO, N.Y. CHICAGO, ILL.

GENERAL SALES AGENTS

The Canadian Fairbanks-Morse Company, Limited

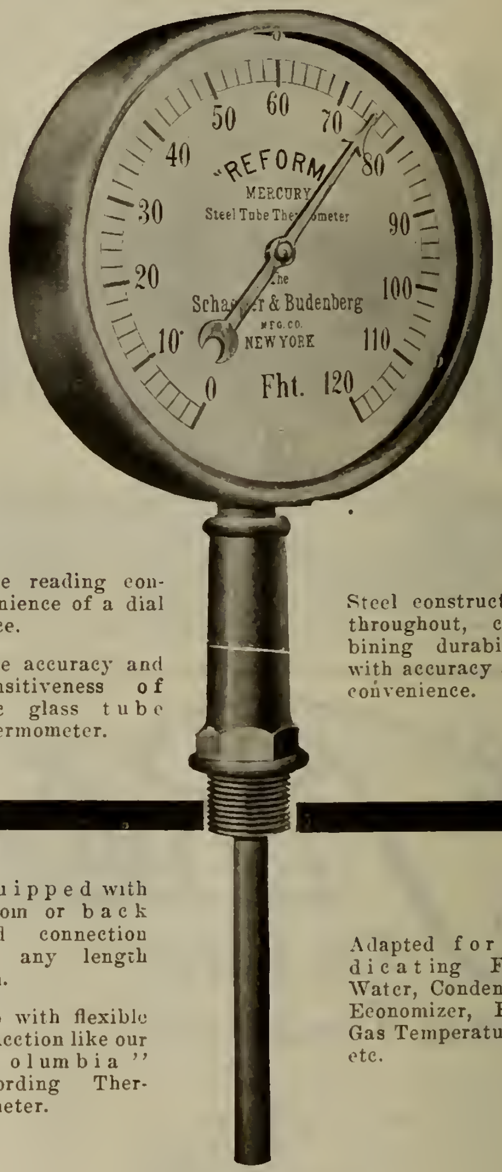
St. John
Quebec
Toronto
Winnipeg
Calgary
Vancouver

Montreal
Ottawa
Hamilton
Saskatoon
Edmonton
Victoria

CFM

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

"REFORM"
Mercury Actuated Dial Thermometer



The reading convenience of a dial face.

The accuracy and sensitiveness of the glass tube thermometer.

Steel construction throughout, combining durability with accuracy and convenience.

Equipped with bottom or back rigid connection and any length stem.

Also with flexible connection like our "Columbia" Recording Thermometer.

Adapted for indicating Feed Water, Condenser, Economizer, Flue Gas Temperatures, etc.

Ask for Pamphlet W-101

THE Schaeffer & Budenberg MFG. CO.

Makers of "Columbia" Recorders, "Crescent" Thermometers, S & B Gauges, Tachometers, Counters, Calorimeters, Indicators, etc.

Berry and South 5th Streets, Brooklyn, N. Y.
Also Chicago, Philadelphia, Pittsburgh.

"Not the slightest odor of gas"

The damage from ammonia fumes is not alone in the "overdose" when there is a "blow," for a slight leakage, if permitted to continue, will eventually affect health.

Engineers, who use P.P.P., tell us that when this packing is properly applied, there is "not the slightest odor of gas."

Among other reasons why you should use P. P. P. are the facts that it saves ammonia, prevents loss of power—due to excessive friction—and does not require constant tinkering and adjusting.

DANIEL'S ROD PACKING P.P.P. FOR AMMONIA PURPOSES

Reg. U. S. Pat. Off.

P.P.P. for Ammonia Purposes is specially prepared, so do not make the mistake of using the kind of P.P.P. you do in engine and pump stuffing-boxes.

If your dealer does not carry P.P.P. for Ammonia, ask him to get it, or write direct to us.

Put Your Problem Up To Us

As the various types of ice machines stuffing boxes create such widely differing conditions that no set rules can be laid down, we advise that you write us, giving make of machine, size of stuffing boxes, etc. If possible, send sketches or blue prints of the boxes.

License Examination Book FREE

Fill out and mail this coupon. We will send you our Blue Book of Questions and Answers to Engineer's License Examinations absolutely FREE.

Your name ....
Address ....
Employed by ....
Address ....
Capacity of Ice Machine ....
Horsepower of engine ....
Brand of Rod Packing used ....
Coil ....Spiral.........Ring.......(Check X)
Form of Packing used ....
Name of Buyer ....
..................................Series 24-C......

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS
PHILADELPHIA, PA., U.S.A.

THE PACKING THAT HAS THE LUBRICANT IN EACH SINGLE STRAND

The Long Service Secured from "PALMETTO" PACKING

TRADE MARK

is due to the lubricant in each single strand, keeping the packing soft and preventing wear of both packing and rod.

Let us send you a free sample to test.

GREENE, TWEED & CO.
SOLE MANUFACTURERS
109 Duane St. New York
Canadian Distributing Agents:
The CANADIAN FAIRBANKS-MORSE CO., LIMITED
Montreal, Ottawa St. John
Toronto, Winnipeg, Calgary,
Saskatoon, Victoria,
Vancouver

Johns-Manville

JOHNS-MANVILLE SERVICE

COVERS THE CONTINENT ©

THE CANADIAN H. W. JOHNS-MANVILLE CO., LTD.
TORONTO MONTREAL
WINNIPEG VANCOUVER

SERVES MORE PEOPLE IN MORE WAYS THAN ANY INSTITUTION OF ITS KIND IN THE WORLD

GIVE a Mexican Indian a coin and he bites it to see that it's genuine. He has no confidence in his government's ability to protect him against counterfeiters. He uses the "eye-tooth test" for silver.

It is purely confidence that Johns-Manville service seeks to build—confidence in the unchanging quality of its products—and in our ability to protect you through J-M Responsibility.

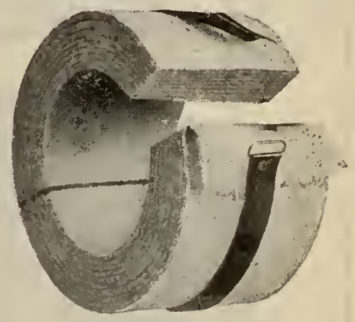
Convert the silent leaking heat into power by using J-M Heat Insulations

You have often thrown coal into a boiler and wondered how much of its energy is actually converted into work by the engine. Plant tests show that the average plant utilizes about 6% of this energy if run efficiently.

Transmission lines form an important link of your efficiency system and they can only measure up to the rest of the system if insulated properly. Every plant has conditions peculiar to itself and needs special insulation for these conditions.

J-M Heat Insulation Service investigates plant conditions and recommends Insulations that produce highest thermal efficiency—a specific insulation for a specific case.

The first cost of J-M Heat Insulation is the only cost—the insulation is practically indestructible. Why not let us help you make the thermal condition of your plant a record-breaker? Write nearest branch.



J-M Asbestos Sponge-Felted. One Style of J-M Heat Insulation.

J-M Sectional Conduit solves the problem of out-of-doors heat transmission

Installing J-M Sectional Conduit at State School of Mines, Rapid City, So. Dak.

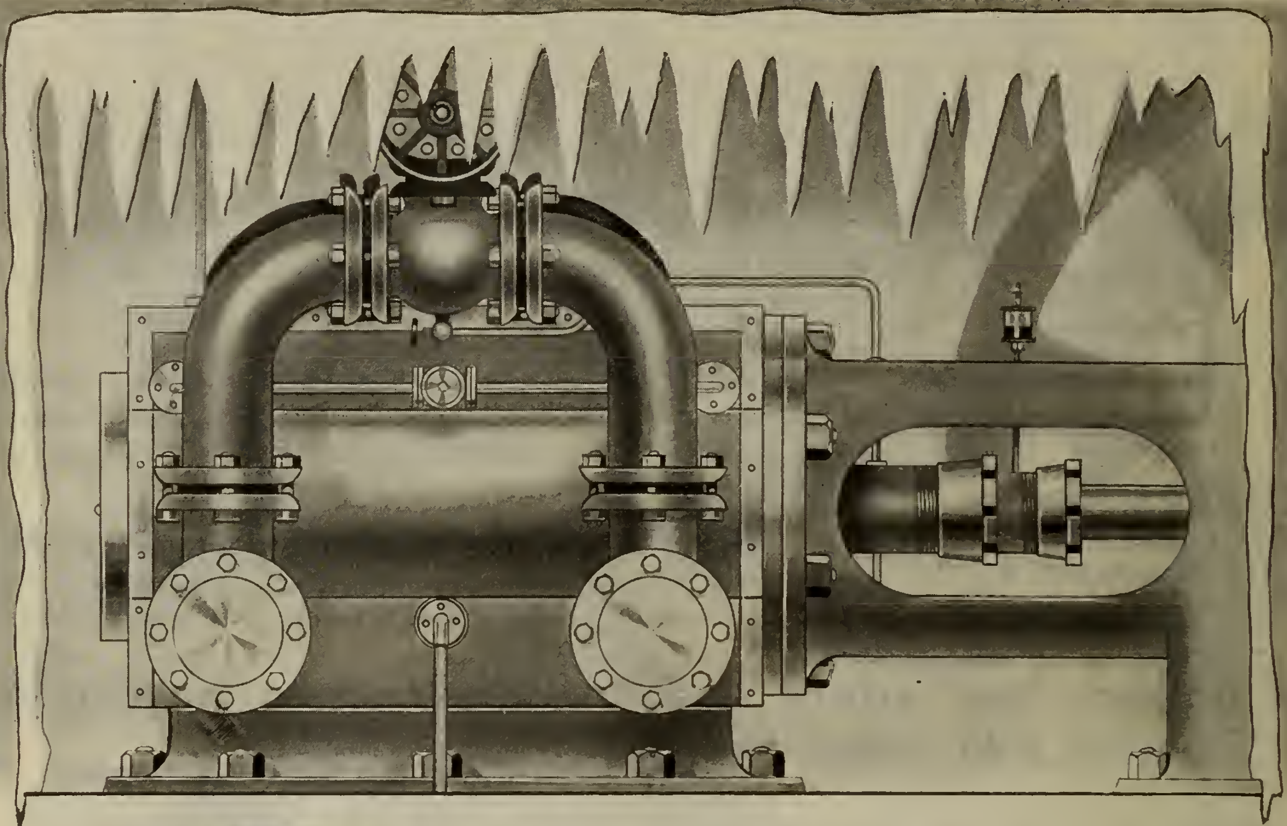
Any group of buildings may now be economically heated from a central plant. The problem of efficiently transmitting live steam, exhaust steam, hot water, etc., underground for long or short distances, finds a satisfying answer in J-M Sectional Conduit.

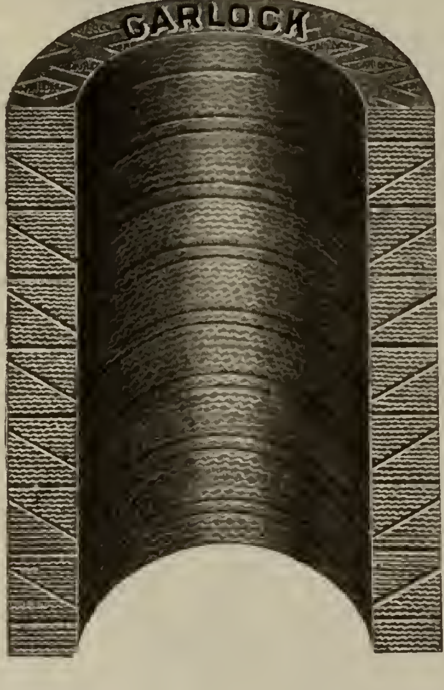
Power in the form of live steam may now be directly transmitted. District heating, utilizing exhaust steam, becomes more profitable.

This system, which is complete in every detail except the steam pipes proper, is fully discussed in a bulletin that every steam engineer should have on file. Nearest branch has it.

31

Service and Responsibility





REFRIGERATING ENGINEERS

and owners of ice plants do not care to experiment with Ammonia Packing during their busy season. Conditions of temperature and lubrication demand a scientifically made, high-grade packing, for this service. Before repacking your compressor stuffing boxes this Spring, write to our nearest branch for catalog, illustrating and describing several styles and combinations of

GARLOCK
Ammonia Packings

or send us a statement of your conditions and requirements and benefit by our many years' experience in this field.

The Garlock Packing Company, Hamilton, Ont.

BRANCHES:

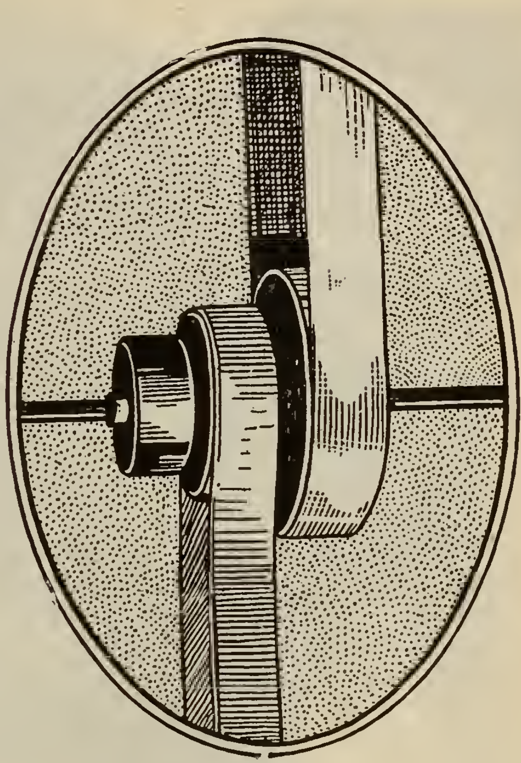
Montreal, Quebec - - - - 342 St. James St.
Toronto, Ontario - - 404 Continental Life Building.
Winnipeg, Manitoba - - - Galt Building.

Mr. Chief Engineer---

When you hire a man you see to it that he has a good record and recommendation.

Why not exercise as much care in employing belting?

You will be keeping yourself on the safe side and you'll eventually be money in pocket by making a thorough investigation of the service of



GENUINE OAK

REGISTERED TRADE MARK

This trade-mark guarantee is on every piece of D. K. McLaren's leather belting. Look for it.

D. K. McLaren's

Genuine British Oak-Tanned

Leather Belting

Now the easiest way to do this is to ask us to give you names of users right in your town, and then call and see the belt in operation and have a talk with the other chief about it. You can judge by what he says whether it would be a good investment or not.

There's no better time than now to do this.

Drop us a card while it's fresh on your mind.

MANY OF CANADA'S LARGEST POWER PLANTS ARE OUR STEADY CUSTOMERS—there's a reason which only the user appreciates.

D·K·McLAREN LIMITED

Head Office and Factory:
351 St. James St., Montreal, P.Q.

TORONTO, ONT. 200 King St. West
ST. JOHN, N.B. 64 Prince William St.
VANCOUVER, B.C. 847 Beatty St.

ENGINEERS SUPPLY CO., 123 Bannatyne Ave. E.,
Winnipeg, Man.

Belting Manual
G&K
This Valuable Book sent all Belt Users for the asking

The "How" Book on Belt Transmission

How to obtain the highest efficiency in power transmission is the problem which confronts every manufacturer. To promote greater efficiency and economy in Belt Transmission is the object of

THE BELTING MANUAL

The Belting Manual, a hand book of 96 pages, substantially bound, is the most complete and concise book published on belt transmission. It tells

- **—how to select belting.**
- **—how to install, lace and care for belting.**
- **—how to make belting endless on pulleys.**
- **—how to find the width, speed and horse-power of belting.**
- **—scores of other "hows" which are constantly coming up in your Power Transmission problems.**

We want to send a copy of this book to every Plant Manager, Superintendent, Purchasing Agent, Foreman, Master Mechanic, Engineer or others who are actually responsible for the selection, installation and upkeep of belting equipment.

If you haven't a Belting Manual write us on your business stationery and a copy will be sent by return mail.

The Graton & Knight Mfg. Co., Oak Leather Tanners and Belt Makers
Worcester, Mass., U.S.A.

Representatives in Canada—THE CANADIAN FAIRBANKS-MORSE CO., LIMITED
St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria

1851 G&K
TRADE MARK REG. U.S. PAT. OFF.

(PATENTED)

The Most Efficient Pulley

THE question of belt pulley efficiency is being agitated to-day as it never was before. Competition among pulley makers has had its share to do in this discussion, but the real reason lies in the fact that millwrights, master mechanics and engineers all over the world are rapidly coming to appreciate that the old rule of thumb methods are out of date. To-day they want *the best pulley,* not just "a pulley."

Careful and elaborate tests made by well-known consulting engineers have conclusively vindicated the claims previously made for the "AMERICAN" Steel Pulley. These tests show that there is less belt slip on this steel pulley than on any other type, whether of steel, cast iron or wood. **Belt slip is power wasted.**

Write to us or to our Canadian representatives for a copy of these tests.

Don't forget, as well, that by using "AMERICAN" steel pulleys with narrow arms properly designed to cut the air, enough power may be saved by reduced windage to pay for the pulley in a few years.

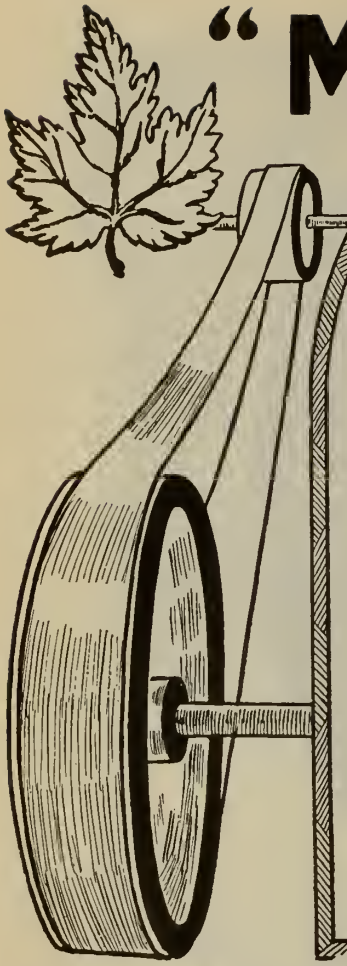
Interchangeable bushings.

Listed sizes 3" to 120" in diameter.

All pulleys guaranteed.

The American Pulley Company
4234-60 Wissahickon Avenue, Philadelphia, Pa., U.S.A.
Williams & Wilson, Limited, Montreal.
The A. R. Williams Machinery Co., Limited, St. John, N.B., Toronto, Winnipeg, Vancouver.

"MAPLE LEAF"



Stitched Cotton Duck
Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying. A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.

MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless

Any Quantity sent
on APPROVAL

The Ladder Is Always In the Wrong
Place And It Has a Habit of Slipping

The Babbitt Adjustable Sprocket Rim

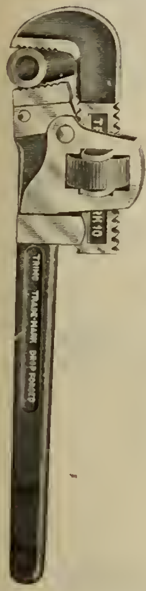
Is SURE To Be In the RIGHT Place and CAN'T Slip

That's the difference between wasting time and saving it—between broken bones and whole ones—between prompt action when promptness means safety, and the delay that spells danger. Nothing like it for opening or closing the out-of-reach valves. The price won't stand in your way for a minute. Ask your dealer. Send us his name and ask for Illustrated Folder.

Babbitt Steam Specialty Co., 59 So. Water Street.
NEW BEDFORD, MASS.

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH



Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union
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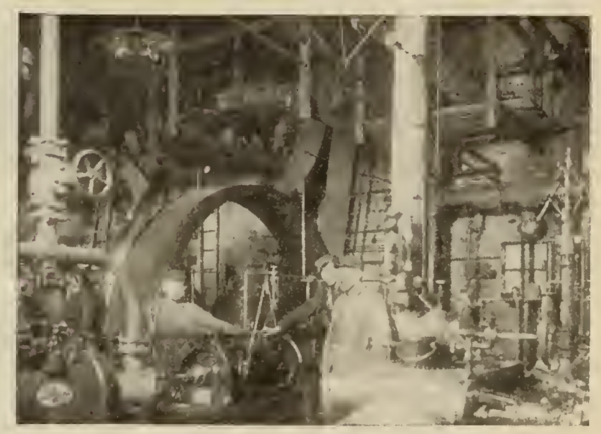

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This 16-in. Gandy belt, pulleys, 12 ft. and 30 in., with 16 feet between centers, is running at 2,340 ft. per min. and is pulling 300 h.p., yet under Cling-Surface treatment and the big sag shown *there is no slip.*

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I am interested in Cling-Surface and your trial order proposition.

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93

A GOOD FRIEND

THE FOREST PARK MILLING COMPANY.
Ottawa, Kansas, March 2, 1915.

Gentlemen:—Magnolia Metal has proven itself a good friend to us in our mill.

Three years ago we babbitted our Universal Sifter boxes with Magnolia, and they are yet in perfect condition, notwithstanding the fact that these bearings had previously caused us considerable trouble. Seeing the results Magnolia has given us, we have no use for any other babbitt metal.

We recently had our engine overhauled by an engineering concern whose mechanics poured "Genuine" Babbitt in the bearings, but which caused considerable trouble from heating when engine was put into service At the same time we took the opportunity of re-babbiting our main drive in which we used Magnolia, and this bearing needed no "doctoring," and surprised the mechanical men at work on our engine, as they did not believe that Magnolia was good enough. We have since regretted that we allowed ourselves to be switched to the other metal on the engine repairs, but you may rest assured that it will be Magnolia Metal at all times in the future.

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MORSE Chain Drive Means More Power

From ¼ H.P. to
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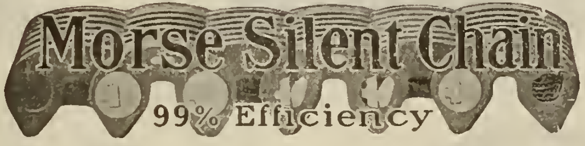

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Why chain drive— Silent chains for transmitting power have now been in use for a number of years, being superior to belting on account of the positive (non-slip) drive feature, adaptability for short centres, less journal friction (because they are always run slack). They are superior to spur gearing on account of quietness at high or low speed, convenience in arranging centers, smoother action, and less repair and maintenance required.

Why MORSE Chains— The MORSE Silent Chain is but one of the several makes in the "silent" type, and it is the only make built upon the "Rocker-Joint" principle (an exclusive patented feature). That this construction is a success and gives complete satisfaction is proved by the fact that over one and one-quarter million horsepower of MORSE "Rocker-Joint" Silent Chains are now in use, included in which is the largest chain drive in the world. *Most* of the other large drives in the world are also of the MORSE type. The "Rocker-Joint" construction substitutes a rolling action for the sliding friction of all other makes, insuring less joint wear and longest chain life, consequently greatest economy. Our nearest office will gladly furnish further particulars if you will send them the coupon below.

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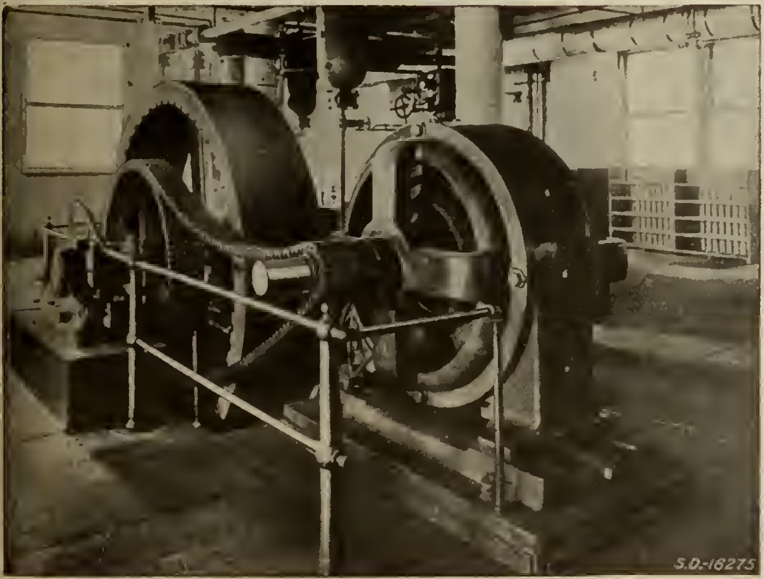

66 H.P. Morse Silent Chain Drive to Air Compressor.

Morse Chain Co.

Gentlemen:—Please send me your latest literature and information relating particularly to the application of

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We are interested in a drive of about ........H.P. for

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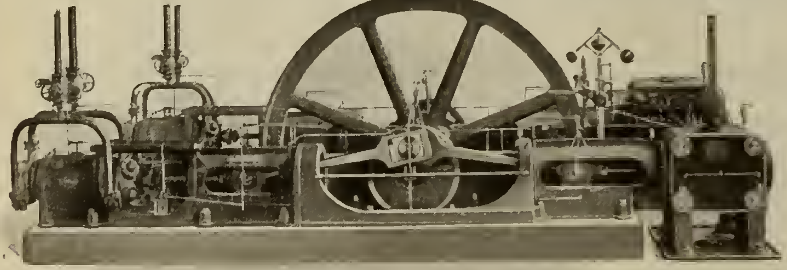

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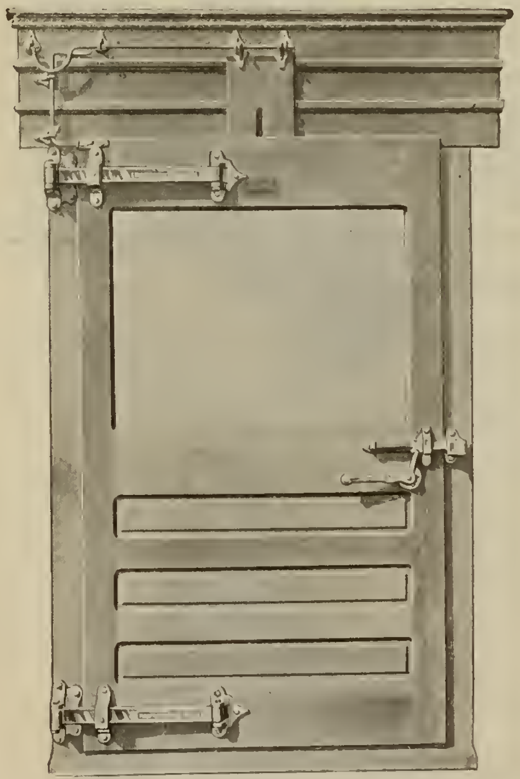

"Jones" Standard Automatic Track Door, Left Hand.

Cold Storage and Freezer Doors either Standard or Fireproof

DOOR

The "Jones" Door, with double seals of contact between the Door and Frame, is the heaviest constructed, most durable and best insulated Door made. Proof—Compare catalogued weights and detail sectional views, or ask P. Burns & Co., Gordon, Ironsides & Fares Co., Canadian Fish & C. S. Co., Prince Rupert; Frontenac Brewing Co., Montreal, Quebec, Canada; Canadian Government Agricultural Dept., or any other large users of Doors of National or International importance. Most of them say "the Door that gives us the least trouble is the 'Jones.'" Built for strength and durability.

We have a new 96-page illustrated catalogued treatise on Insulated Doors. The most complete ever issued, free for the asking. It describes, in addition to the above:

The "Jones" Cold Storage Window.
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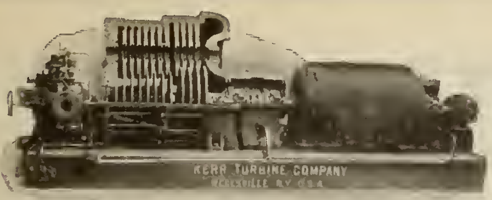

500 KW Turbo Alternator.

Note Accessibility.

'KERR ECONOMY' Steam Turbines

Built for high pressure, condensing or non-condensing operation, and for low and mixed pressure (exhaust steam) condensing. Connected direct or thorough highly accurate and quiet "Kerr Economy" Herringbone Reduction Gears to generators, pumps, blowers, etc., and for belt or rope drive. Let us send you our descriptive and illustrative bulletins, free of charge.

Specify "Kerr Economy" and protect your investment.

KERR TURBINE COMPANY
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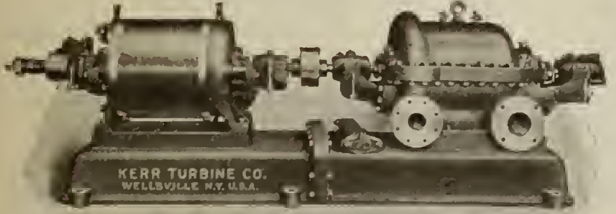
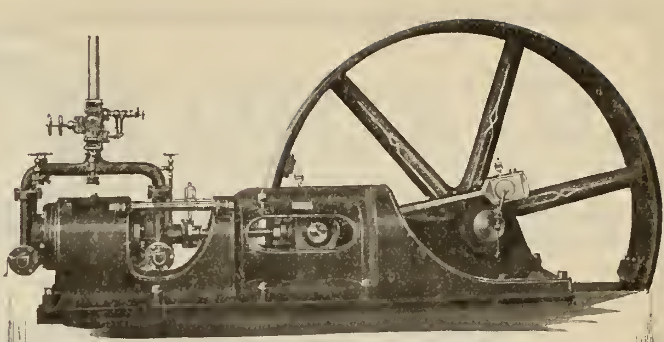
Offices in Montreal, Toronto, Winnipeg, Vancouver and all large cities in the United States.



"Economy" Turbo-Pumps for all classes of service, described in Bulletin No. 52.



When you are in the market for a high-class ice-making or refrigerating plant, do not overlook the service and equipment which we have to offer. It is worth your careful investigation. *Your inquiry will be appreciated.*

THE HUETTEMAN & CRAMER COMPANY
Manufacturers of
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DETROIT, 43rd Year. MICHIGAN, U.S.A.

YORK Enclosed Refrigerating Machine
LATEST TYPE

Poppet discharge valve and cage in safety head, floating suction valve, ample port areas, compressors reamed to size, and pistons with ground cylindrical surface and ground snap rings—combine to make a MOST EFFICIENT AMMONIA PUMP.

Removable Strainer inside of the Machine, at the extreme end of the Suction Line, prevents any dirt or pipe scale from entering the Compressor.

Die Forged Crank Shaft, ground to gauge. Cast Steel Connecting Rods, both ends bored and reamed at same time, insuring perfect alignment between wrist and crank pins.

Die Cast Bearings throughout—an exclusive feature in YORK Enclosed Machines.

$\frac{1}{8}$-ton Refrigerating capacity and upward.

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QUALITY

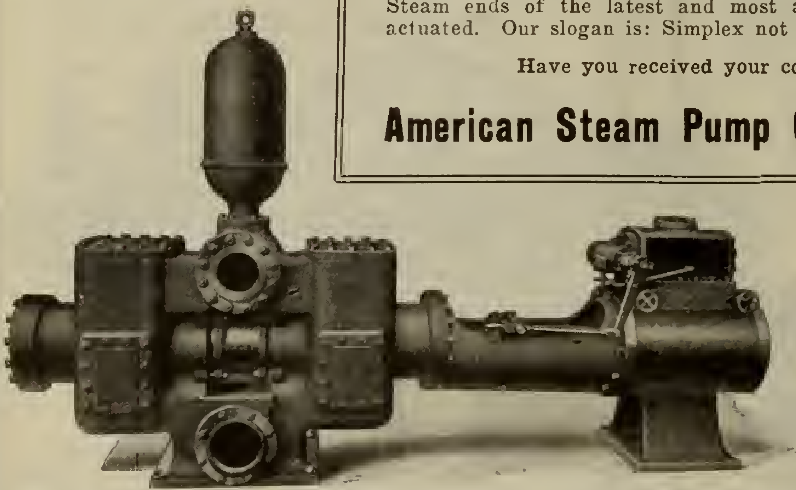
Is always present in

"AMERICAN" STEAM and POWER DRIVEN PUMPS

They are the result of over twenty-five years' experience in the design and construction of high-grade pumping machinery. Note the heavy, solid construction. Solid bronze piston rods and heavy cast bronze removable water cylinder bushings. Steam ends of the latest and most approved balanced piston type, mechanically actuated. Our slogan is: Simplex not Duplex, "To be simple is to be great."

Have you received your copy of our new Bulletin Catalog?

American Steam Pump Co., Battle Creek, Michigan



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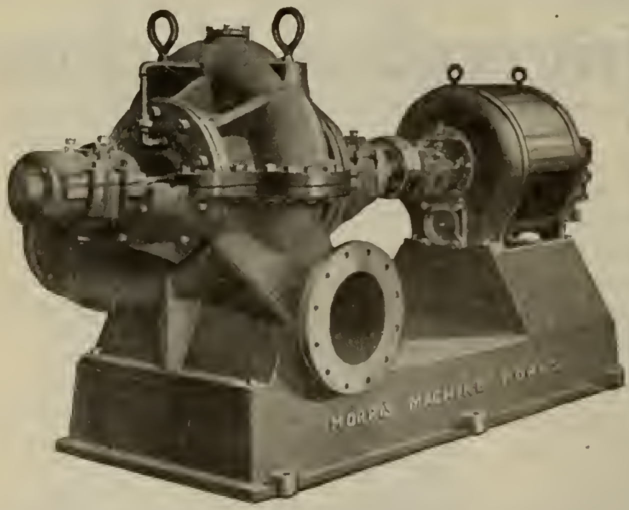

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The "Morris" Horizontally Split Shell Centrifugal Pump is very popular with pump users — can be inspected quickly without breaking pipe connections.

THE LATEST UP-TO-DATE DESIGN BACKED BY HALF A CENTURY'S PUMP EXPERIENCE

The cut shows a steam turbine driven pump, the same design being used for motor and other drives. We build centrifugal pumps for all services, including BOILER FEEDING, TANK PUMPING, GENERAL WATER SUPPLY, BRINE WORK, ETC. Send us your inquiries for pumps of all types.

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MORRIS MACHINE WORKS, BALDWINSVILLE, N.Y.

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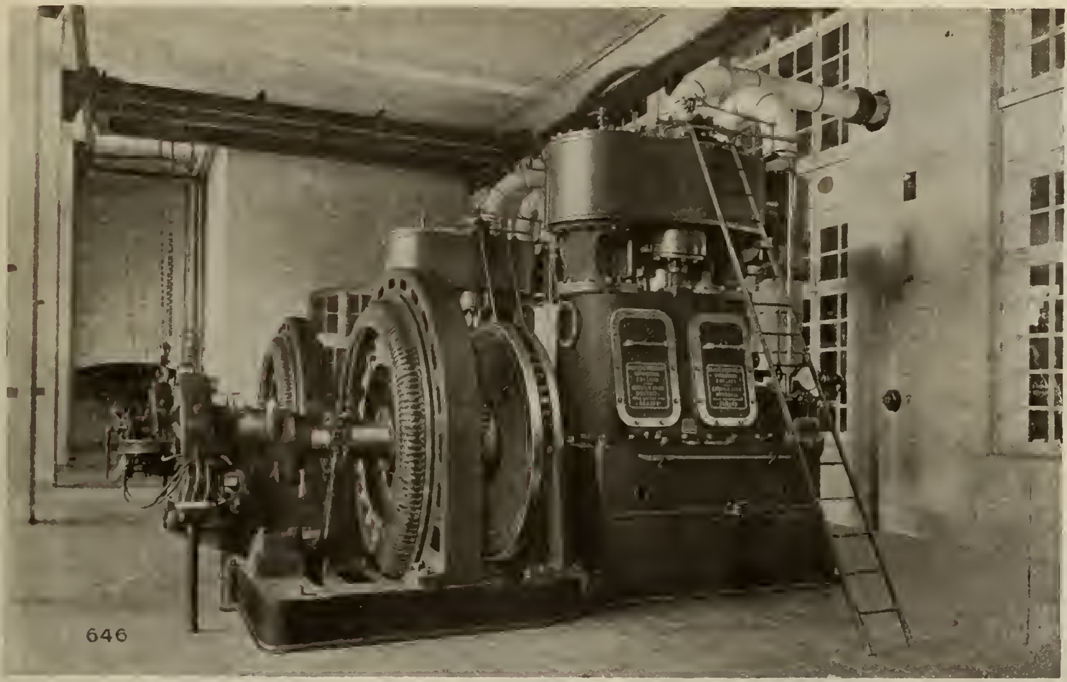

2-400 Kilowatt Belliss & Morcom High-Speed Engines.
MONTREAL NEW JAIL. BORDEAUX, QUE.

WE HAVE FOR IMMEDIATE DELIVERY, A NEW ENGINE GENERATOR SET. AN EXACT DUPLICATE OF THE ABOVE. WRITE FOR PARTICULARS.

Send Us Your Enquiries For

CENTRIFUGAL PUMPS

Steam Engines, Boiler Feed Pumps, Condensing Plants, Producer Gas Engines, Air Compressors, Oil Engines, Steam Turbines, V-notch Water Meters.

Complete Power Plant Equipment.

We can offer a large assortment of machinery for immediate shipment

LAURIE & LAMB

Engineers

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THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps—centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

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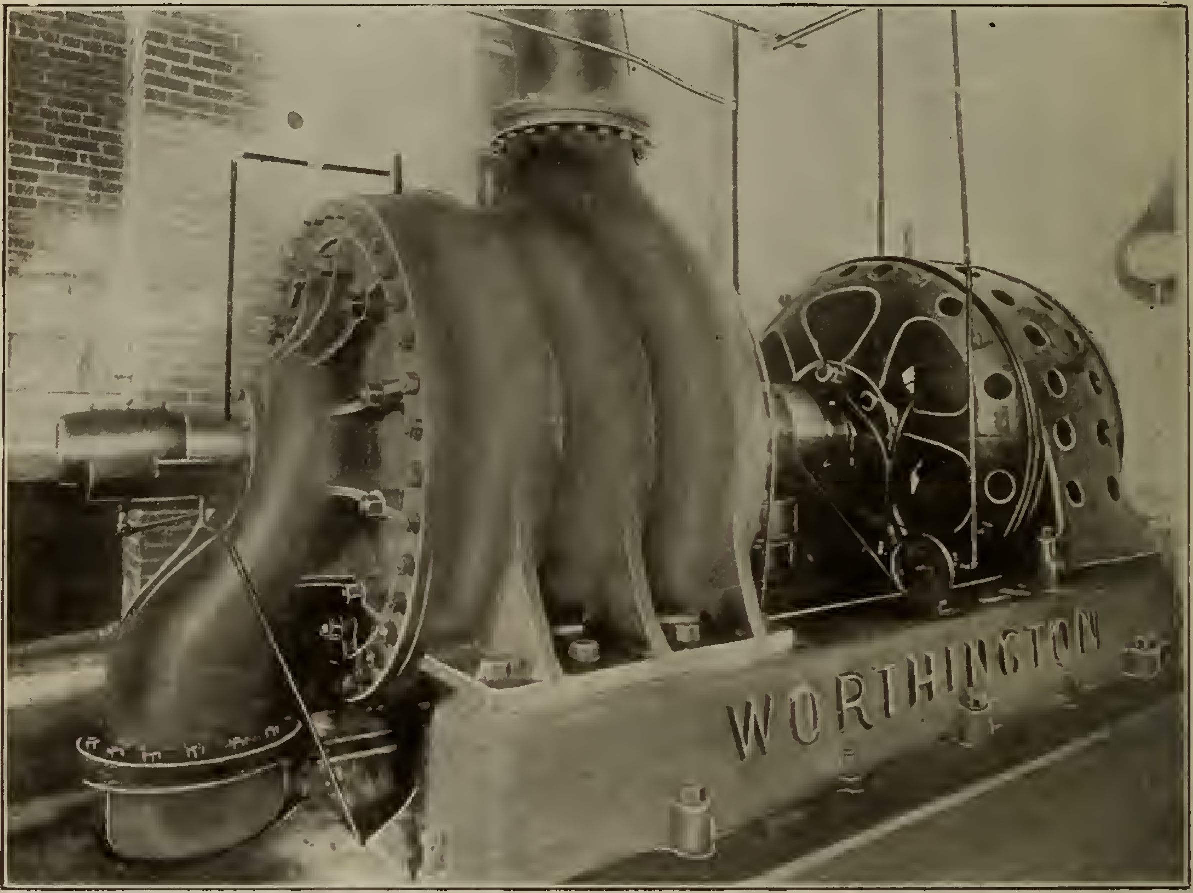

5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment
of their Boiler, Feed and General Service Pumps

The Publisher's Page

By B.G.N.

Concerning Advertising

Extracted from an address before the Technical Publicity Association, N.Y.
By W. L. SAUNDERS, *Chairman of the Board,*
INGERSOLL-RAND CO.

Good technical advertising is essentially concrete. It is an exact science, and knowledge of the subject is the first qualification; everything else is secondary to this. Technical advertising involves salesmanship of the highest order. It is not the gift of gab that counts; is not a polished manner or a pleasing presence, but it is familiarity with the thing advertised in all its bearings, which involves a wide general knowledge of the product and business; next a faculty of clear, brief and direct expression. Proper display is not to be neglected, but this is easy.

Advertising affords a means by which the man who knows most about the business may imprint his ideas effectively upon the minds of thousands. His audience is the world, and in no other way can he bring up the average efficiency in productive results. He may not do as much good in each case as though he met the customer personally, but on the whole he creates a greater general impression and paves the way for personal interviews that follow. I speak as one of experience in these matters. Up to recent years I have personally been the advertising man of the interests in my charge.

I realize that the head of the business can well afford to spend his time and energies directing the fundamental conditions that govern good technical advertising. I also realize that there is no fire of genius whatever in this matter and here we must distinguish between technical and general advertising, just as we must distinguish between technical and general salesmanship. A good talker can sell patent medicines regardless of whether they do the customer any good or not. A genius can put a patent medicine on the market and make a fortune out of it, regardless of its merit, but in technical advertising, as in technical selling, the gift of gab is one of the lesser, not greater virtues.

No one with common sense doubts the value of advertising—the only doubt is the value of the man who advertises. You must first establish confidence in the product that you are handling or you can never be successful on large lines. It is just as important that you should thoroughly believe in the thing that you are advertising as it is that the man who hires you should thoroughly believe in you. Confidence is the key-note of it all.

POWER PUMPS

Inside and Outside Packed Steam Boiler Feed Pumps, Turbine Driven Boiler Feed Pumps.

G. & McC. Co. Turbine Driven Pumping Units are
EFFICIENT - RELIABLE - ECONOMICAL

They are simple to operate, are free from excessive noise and vibration, not requiring expensive foundations and are low in first cost and operation maintenance.

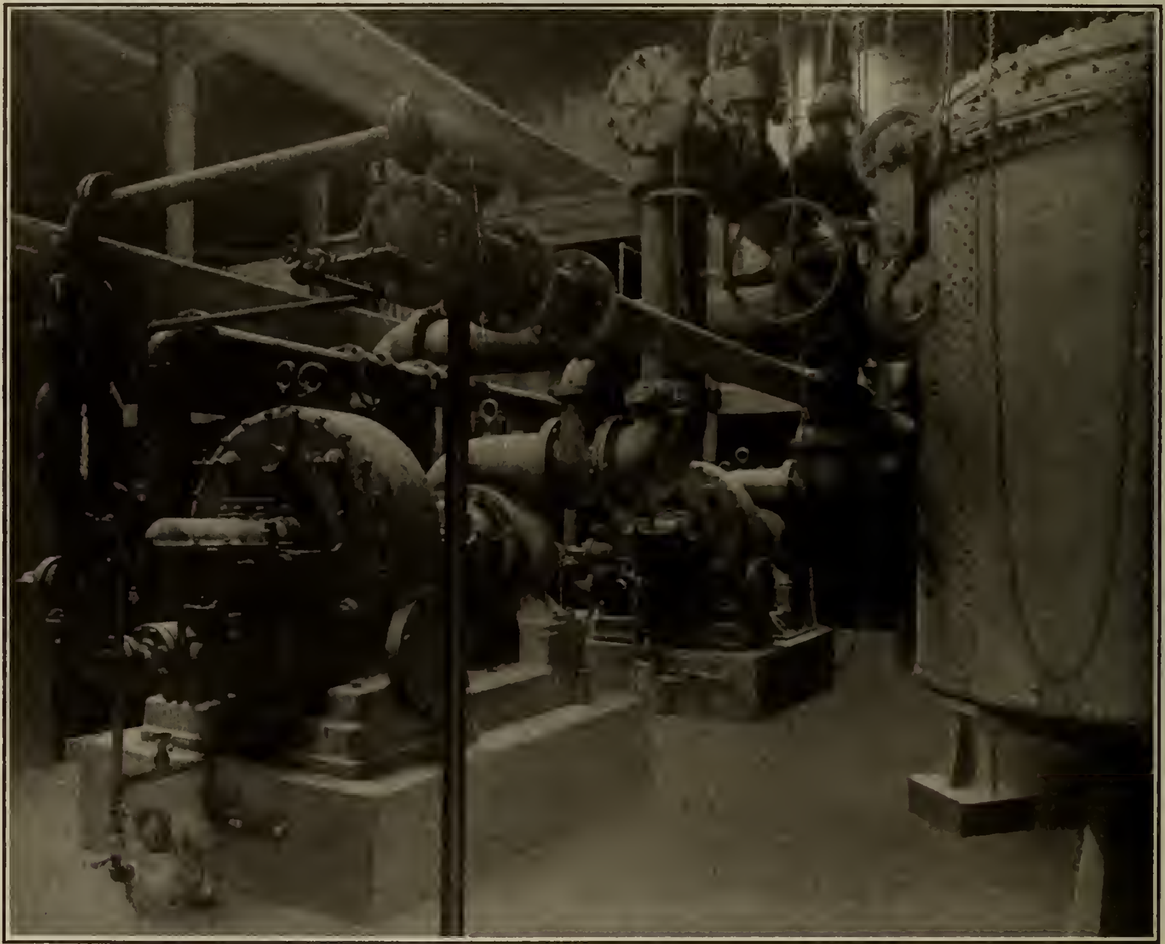

Illustration shows Two Turbine Driven Pumping Units which we have recently Installed at Power Plant of The Hospital for the Insane, Whitby, Ont.

The Lubricating System is entirely automatic, requiring but a small fraction of the amount of oil used in a reciprocating set, and owing to the freedom from oil, the exhaust may be passed directly to the Heater for Boiler Feed, or other manufacturing purposes.

We build both High Pressure and Exhaust Steam Turbines. Ask us for further information.

THE GOLDIE & McCULLOCH CO., LIMITED

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TORONTO OFFICE:	WESTERN BRANCH:	QUEBEC AGENTS:	BRITISH COLUMBIA AGENTS:
Suite 1101-2 Traders Bank Building.	248 McDermott Ave., WINNIPEG, MAN.	Ross & Greig, 412 St. James St. MONTREAL, QUE.	Robt. Hamilton & Co., VANCOUVER, B.C.

Stand-by Steam Plant, B.C. Electric Railway, Vancouver

By A. F. Menzies

The electric railroad has become so important a factor in our city, suburban and rural activities, that the slightest interference with its continuous operation or maintenance of schedule sets us "by the ears," so to speak, particularly if our personal arrangements become involved. To minimize inconvenience of patrons, a dual source of operative power is in most cases provided—primary or hydro-electric, and secondary or steam electric. The accompanying article deals with an installation of the latter, and as will be noted, the equipment layout is on quite a comprehensive scale, being at the same time modern and quickly serviceable.

JUST off Main street, Vancouver, and behind the sub-station in which hum the familiar "rotaries" is a power plant for the generation of electricity, maintained by the British Columbia Electric Railway Co. Its purpose is that of a stand-by in case of accident at their hydro-electric station, Lake Buntzen, or on the transmission lines from there to the city. Being of the stand-by nature the plant is not normally in operation; but steam is kept up on a certain number of boilers and a turbine is always ready to cut in at a moment's notice. The plant is housed in a building about 200 feet by 118 feet. The boiler house is 100 feet by 118 feet. while the engine room is of brick and approximately the same size, with a steel truss roof of nearly 100 foot span.

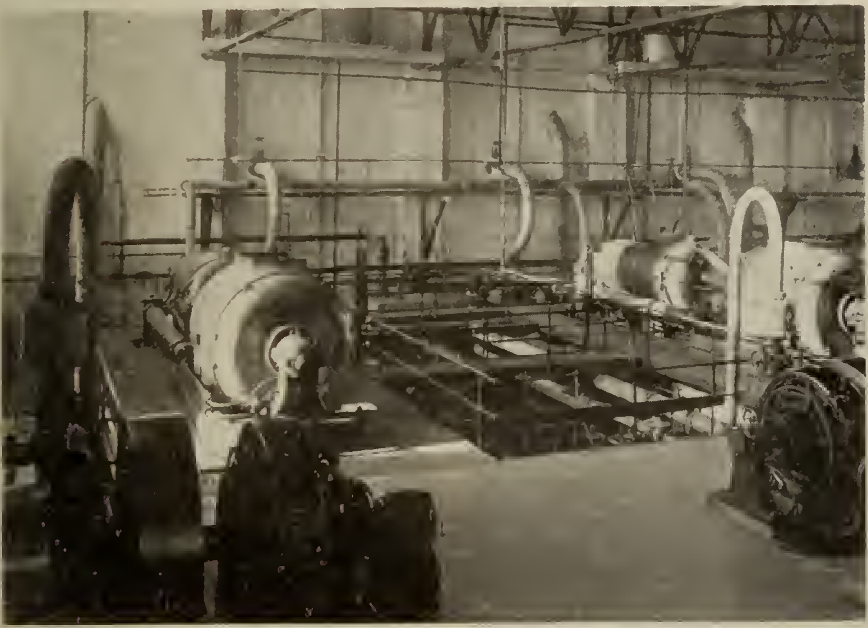

FIG. 1. SHOWING PORTION OF STEAM TURBINE ROOM.

Boiler Installation

The boiler house contains twelve Babcock & Willcox water tube boilers, built at Renfrew, Scotland. The boilers are arranged in two batteries, facing each other and each battery contains three sets of boilers, a passage way being left between each set. The boilers each have about 4.800 sq. ft. of heating surface. and are rated, under B.C. rules, at 318.6 horse-power, making a total for the plant of 3,823 boiler horse-power. The pressure allowed on the boilers is 200 lbs. per sq. in.; but as the turbines take steam at only 150 lbs. per sq. in., the safety valves are set for 175 lbs., which amply provides for drop, etc.

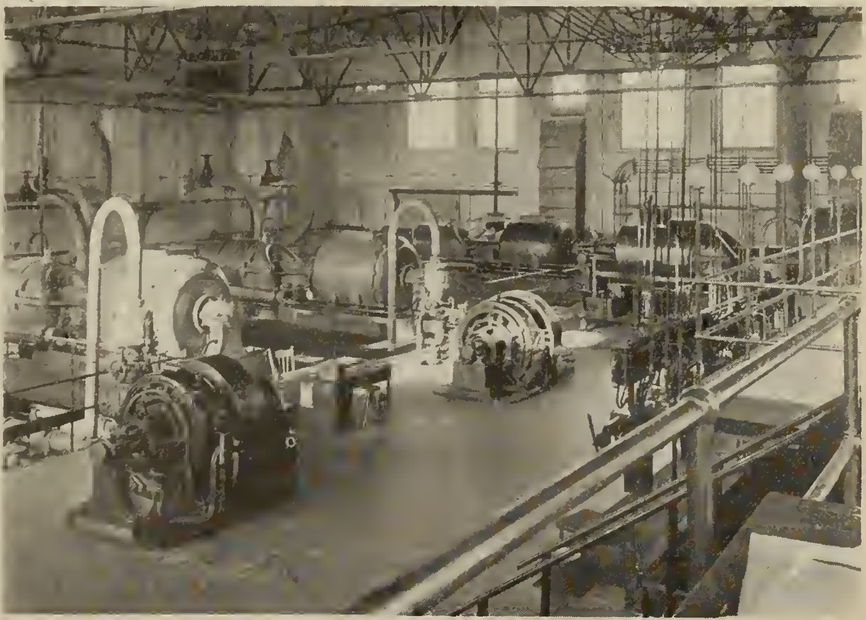

FIG. 2. SHOWING PORTION OF STEAM TURBINE ROOM.

Oil Fuel Feature

The boilers were originally fitted with chain grate stokers for burning coal; but recently the entire equipment was changed over to burn liquid fuel, two boilers being changed at a time. The oil-burning system used is automatic in action, the fires being once set away and properly regulated, the steam pressure in the boilers controlling the supply of fuel and atomizing steam to the furnaces. A drop in steam pressure will increase the fuel and steam supply and also increase the opening of the dampers, whereby a larger supply of air will be admitted to the furnaces.

The oil is pumped from two steel supply tanks, each holding 1,200 bbls, by two Platt Iron Works duplex pumps, arranged so that either can be used independently of the other. There is a by-pass cock connecting the oil pump discharge to the suction and by regulating this cock the fuel supply to the furnaces is controlled. After passing a "Worthington" piston oil meter, in which all the oil consumed is measured, the fuel is heated to the required temperature for perfect combustion, by live steam in two closed heaters. From the heaters the fuel pipes are led along the stokehold, in front of the boilers, with branches to each boiler. The steam for atomizing purposes is led beside the fuel pipes making a handy and convenient arrangement.

In order to provide a means of starting up the oil fires should it be necessary to let steam down on all boilers, a small air compressing outfit is provided, consisting of a Canadian Ingersoll-Rand horizontal air compressor geared to a Canadian Fairbanks-Morse 10 h.p. 220 volt, 900 r.p.m., induction motor.

Each battery of boilers is provided with an independent smoke stack, and these, being 240 feet high, form a landmark that is visible for many miles around. The stacks are 14 feet in diameter, at the bottom and 11 feet diameter at the top, the lower portion being air-cooled. They are constructed of reinforced concrete and were built by the Weber Chimney Co., Chicago, Ill.

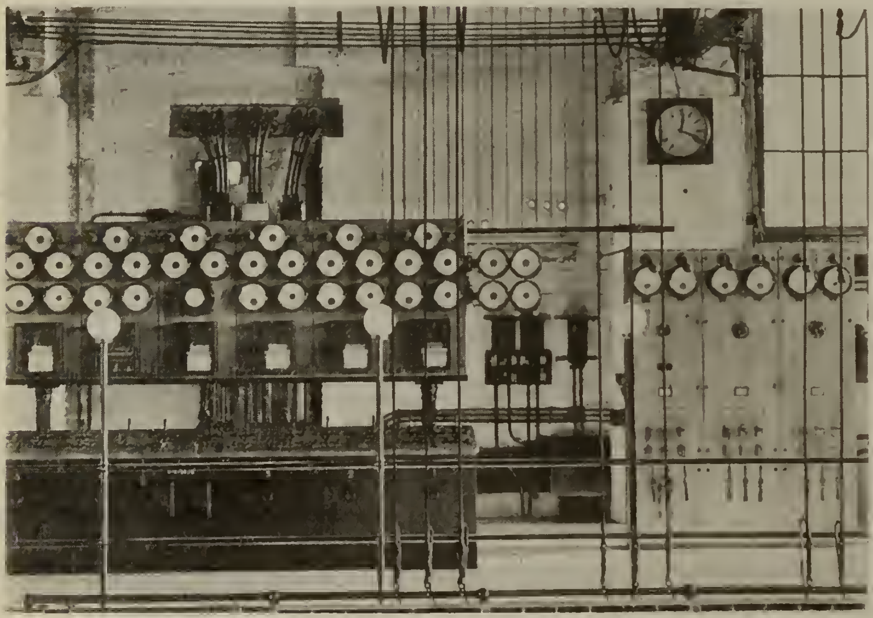

FIG. 3. SWITCHBOARD OF STAND-BY STEAM POWER PLANT.

Piping and Valves

The main steam header forms a complete loop, embracing all the boilers, branch pipes, and long sweep bends, which connect the boilers to the header. The branches are provided with an automatic stop valve at the boiler end and a gate valve at the entrance to the header. The stop vales are arranged so that on cutting-in a boiler the valve opens automatically when the pressure in same equals that in the header. Stop valves are provided in the header, between each pair of boilers, so that, in the event of accident to any boiler, two at the most will be out of commission. The header is constructed of steel pipe, joints being made on the "Vanstone" principle, the flanges being loose and slipped on the pipe, the end of the latter being afterwards spread out to retain the flange. The supports for the header are cast iron chairs which are allowed to slide on brackets to compensate for expansion or contraction due to changing temperature.

Each boiler is equipped with a 5 in. C.G.E. indicating steam flow meter, the connection being made on the lead from the boiler to the header. Several connections are also provided in various parts of the plant for a portable steam flow meter of the same make. All live steam pipes, hot feed water and hot oil pipes are insulated with a covering of 85 per cent. magnesia, supplied by the Canadian H. W. Johns-Manville Co.

Power Generating Equipment

The electric generators consist of five units, all built by the Allis-Chalmers Co., Milwaukee, Wis., the turbine end being built under license from the C. A. Parsons Co., of Newcastle-on-Tyne, England. There are four generators of 2,000 k.w.. and one of 4,500 k.w. capacity, delivering 60-cycle, 3-phase current at 2,300 volts. The turbo-generator foundations comprise two concrete pillars rising from a block of the same material carried down to hard pan, one pillar carrying the turbine and the other the generator. The space between the pillars is used to house the condenser, thus bringing the latter directly under the turbine exhaust. The generators are cooled by the fan action of the revolving field, large galvanized iron pipes being provided to remove the heated air to the outside of the building. Two of these pipes can be seen in the illustration leading out of the lower portion of the windows. Figs. 1 and 2 give a comprehensive view of the whole turbine room, the 4,500 k.w. turbo-generator is that on the extreme right.

The steam supply to the turbines is delivered at 150 lbs. per sq. in., by branch pipes leading from the main steam header, which runs along the boiler house side of the dividing wall. The branch pipes can be seen in the photos. where they come through the wall.

Exciters

There are four exciter sets provided, three of which are steam driven, and the other motor driven. The steam sets. which show in the foreground of Figs. 1 and 2, comprise two "Ideal" horizontal steam engines built by A. Lide & Sons. Springfield, Ill., and one "Robb Armstrong" built by the Robb Engineering Co., of Amherst, N.S. Of the former, one is a 16 in. x 18 in. unit running at 225 r.p.m., equipped with a fly-wheel governor and "Hart" force feed lubrication to the cylinder. The generator is direct coupled and is a 150 k.w., 125 volt, direct current machine, built by the Canadian Westinghouse Co. The other "Ideal" set is a 13 in. x 14 in. unit, and runs at 265 r.p.m. It is coupled to an Allis-Chalmers direct current generator giving 800 amps. at 125 volts. The Robb engine unit is 11 in x 14 in.. and is direct coupled to a Canadian Westinghouse 75 k.w. direct current generator running at 265 r.p.m. In order to insure a supply of dry steam to these units. steam separators are provided and located just above the stop valves. The motor generator exciter set comprises a 75 k.w., 125 volt. direct current generator coupled to a 110 h.p. 2,200 volt induction motor running at 1,200 r.p.m. This set was supplied by the Canadian General Electric Company.

Condensers and Pumps

As previously mentioned. the condensers are located directly under their respective turbines. the exhaust connection being a short length of corrugated copper pipe. Atmospheric exhaust relief valves are provided. The exhaust pipes from these valves can be seen in the illustrations rising up the far wall and passing through it. The condensers and related equipment were all supplied by the Wheeler Condenser & Engineering Co.. of New York. They are of the surface type and are provided with reciprocating dry air pumps and centrifugal hotwell pumps. The vacuum ordinarily maintained is 28 inches. Tracks consisting of I beams are provided above the condenser doors to facilitate their removal; small inspection holes are also provided in the doors.

The air pumps are steam driven horizontal machines and those in connection with the 2,000 k.w. turbo-generators are 8 in. x 18 in. x 12 in.. having the crank shaft between the cylinders and a flywheel on each side. The valves in the air end are mechanically operated from the crank shaft. while the air piston is driven by two rods extending from the cross head and straddling the shaft. The steam valves are of the oscillating type located on top of the cylinder, and are driven from an eccentric on the crank shaft. These air pumps are located about the condenser level below the engine room floor. The air pump for the 4.500 turbine is similar to the above; but is a 10 in. x 26 in. x 18 in. machine with the air pump bucket on an extension of the piston rod. It is located on the main floor, beside the turbine.

Each condenser is provided with a mercury column vacuum gauge, showing the pressure against which the turbine is exhausting. Two of these gauges can be seen in Fig. 1, standing above the railing round the opening to the condenser pit; they were supplied by the Hohman & Maurer Mfg. Co., of Rochester, N.Y.

The centrifugal hotwell pumps are located a few feet below the condenser level in a small pit between each pair of condensers, each pit containing two pumps. The pumps are driven by 5 b. h.p., single stage Kerr steam turbines running at 1,800 r.p.m. They have 2½ in. connections to the hotwells formed on the bottoms of the condensers, and to the Cochrane feed water heaters and purifiers.

The condenser circulating water is supplied from False Creek, a natural extension of the sea into the heart of the city. There are five centrifugal circulating pumps located in a pump house on the shore of the creek, about 300 yards from the power house. Four of the pumps are 14 in. and are coupled to 50 h.p. 2.200 volt, 900 r.p.m. Allis-Chalmers induction motors. The remaining pump is 20 in., and is coupled to a 150 h.p. motor. These five pumps were supplied by the Wheeler Co. They are all controlled from the power house, the motor starting compensators being located in front of the switch-board platform. The wires leading from the compensators can be seen in Fig. 2. A double screen is provided to keep debris from entering the pumps and being driven on to choke condenser tubes, etc. The inner screen is formed of wire mesh and a winch is provided for raising it in sections for cleaning. A submerged outlet for the circulating water is provided, this line being constructed of wood stave pipe and its outlet laid below low water line in the creek.

Boiler Feed Water

The feed water is taken care of by three individual pumps. One, a 6 in. turbine driven, three-stage centrifugal is capable of delivering 650 gallons per minute and can carry the whole load. The pump end was constructed by the Blatt Iron Works, Dayton, Ohio, while the driving turbine is a Kerr multistage. It is rated at 140 b.h.p., and runs at 2,000 r.p.m. Besides the centrifugal governor on the shaft, a throttling governor, operated by the feed water pressure is provided. A by-pass is arranged so that this device may be cut-out if necessary, for starting up, etc. Two Warren 14 in. x 9½ in. x 18 in. duplex pumps of the outside packed type are also used on the feed line. These pumps have brass plunger and pot valves and are provided with water governors operated by the discharge pressure. Two Cochrane feed water heaters and purifiers from which the feed pumps draw, were supplied by the Harrison Safety Boiler Works, Philadelphia, Pa. By means of the exhaust steam from the auxiliary machinery the feed water is heated to a temperature of about 210 degrees F.

Before delivery to the boilers all the feed water is passed through a 6 in. Venturi meter, which records and indicates the amount. The meter column is located in the engine room by the gauge board, while the meter itself is in the connecting pipe between the feed pump discharge header and the main feed header which completely circles all the boilers similarly to the main steam header. The required make-up feed is drawn from the city of Vancouver water mains.

Switch Board

The switch-board which is well shown in Fig. 3, was supplied by the Canadian Westinghouse Co.; it is of thick dark marble and has a very pleasing appearance. The main board comprises one panel for each of the five generators and one main panel, to which is connected the outgoing lines. The generator panels are provided with an ammeter for each phase, a power factor meter and a graphic watt meter which indicates the instantaneous power being delivered and records the same on a chart. The main panel is similarly equipped except that the ammeters have a higher range and an integrating watt hour meter is provided. The dials of this instrument give the kilowatt hours which the plant has delivered to the mains.

The board is provided with remote control, the controlling switches being mounted on the desk board in front of that which carries the meters, etc. The desk is provided with red and green indicating lamps, showing whether the corresponding switch is in or out. The main switches are located under the platform carrying the board and are provided with separate oil reservoirs for each leg. The operating current for the control of the board is 125 volts d.c., and is taken—either from the exciter circuits or from a storage battery in the substation adjoining the plant. The small two-throw switch near the bottom of the left panel of the exciter board puts battery or exciter current on the main control.

A swing panel to the right of the main board carries a couple of volt meters, a frequency meter and a synchroscope. One of the volt meters shows the pressure being generated and the other the pressure on the bus bars in the sub-station, to which this plant delivers its electrical energy.

The exciter board, shown on the right in Fig. 3 has three panels equipped with voltage regulating rheostats, volt and ammeters, together with the necessary switches. The clock on the wall above the exciter board is one of a series of electric time-pieces maintained by the company in its various offices, etc., in the city. They are all synchronized by a master clock at headquarters. The platform surrounding the switch board is of white tile, and is enclosed by a brass railing, the stanchions of which are extended and carry incandescent lamps in ground glass globes.

◆

LOW PRESSURE TURBINE USING HAMMER EXHAUST

THE Rockford Drop Forge Co., Rockford, Ill., is installing a 300-k.w. Westinghouse low-pressure turbo-generator set to operate on exhaust steam from the hammers in the forge shop. The hammers number 17, and range in capacity from 800 to 4,000 lb. The exhaust steam is collected in a 10-in. overhead main, and the distance to the turbine station approximates 125 ft. The steam is used at a pressure of 2 lb. at the turbine, and connection is made with the live steam main through a reducing pressure regulator, so that inadequacy of exhaust steam at any time is compensated for automatically.

This turbine unit will supply power for the die-sinking department, and it will also provide for the requirements of the adjacent Mechanics Machine Co., replacing electric power previously purchased. Heretofore the exhaust has only been utilized for shop heating and feed-water heaters, the greater portion having been wasted. With the new turbo-generator unit, a saving of $1,000 per month is figured.

◆

Minor Use of Flywheels.—In some cases the flywheel is only required to equalize the driving, for which purpose it is only necessary that the mounting and keying of the wheel upon the shaft should suffice for the transmission of surplus power to the wheel so as to control the speed of the wheel during the storage of work. Alternately, the work is restored to the shaft, and thereby minimizes the amount of reduction in speed which would occur in the absence of, or deficiency in, the flywheel.

Steam Turbine Driven Centrifugal Pump Installation

By C. T. R.

The equipment here described is indicative of the progressive spirit being manifested by Canadian builders of steam and hydraulic machinery. Steam turbines, while not unknown as far as many of our power plant installations are concerned, have for the most part been imported; interest in the accompanying article is therefore intensified, featuring as it does the home product both in constructional detail and in successful service application.

THE pumping installation illustrated in Fig. 1 was recently supplied to the Department of the Interior for the purpose of circulating the water for the heating system at the Hospital for the Insane, situated at Whitby, Ont. The pumps were made by the John Inglis Co., Toronto, and are of the centrifugal single stage, double suction, horizontal type, the main casing being in the form of a cast iron volute, with substantial feet for bolting to the base plate. The suction nozzle is also cast on so that side covers which fit into the volute with male and female joints connect to the suction nozzle. This construction makes it possible to bore, turn and polish the interior of the casing and allows the pump to be dismantled or assembled without breaking pipe joints. The nozzles can be made to fit in any direction required.

The impeller is of cast bronze, highly polished and balanced for the required speed. It is of the double suction type keyed and locked on the shaft. The shaft is of best hammered steel and brass bushed where it extends through the stuffing boxes. Adjustable steel collars turned from the solid are fitted on shaft over feather key and locked where necessary. Mounted on the side of the cover next to the turbine is a two-piece combination bearing and a water-cooled thrust for holding the revolving parts in their proper place. On the outer end cover is mounted a two-piece oil ring lubricated bearing. Both bearings are babbitt lined. Extending full length under both pump and turbine is a cast iron base plate of box section, faced where necessary for bolting and dowelling the pump and turbine into line.

Steam Turbine Feature

The pumps are guaranteed to deliver continuously 2,750 U.S. gallons of water per minute at a temperature of 165 degs. F. against a total friction head of 110 feet when operating at approximately 1,500 r.p.m. A flexible coupling connects the pump to a steam turbine of 125 b.h.p., when operating at 140 pounds gauge with a back pressure of 5 lbs. gauge. The turbines were manufactured and supplied by the Goldie & McCulloch Co., Galt, Ont., who, we understand, are the only manufacturers of steam turbines in Canada at the present time.

Fig. 2 shows a cross section through the turbine which is of the single pressure, double velocity type, the steam path being shown in Fig. 3. The steam expands to approximately the exhaust pressure in the nozzles and after passing through the wheel blades the first time, continues by its residual velocity and is returned for a second impact on the wheel blades.

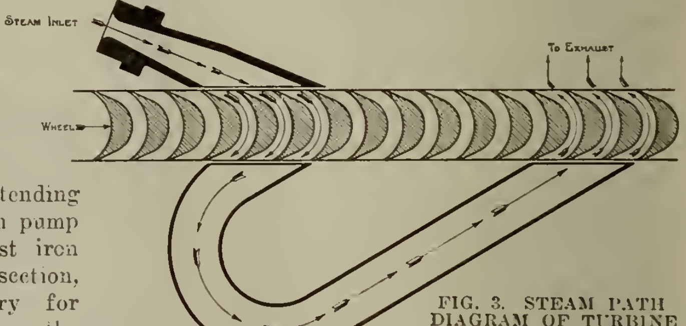

FIG. 3. STEAM PATH DIAGRAM OF TURBINE.

There are four nozzles which may be controlled by hand to suit the load conditions, and by this means a fairly constant efficiency may be maintained over a considerable range of load. The turbines for these units were, however, only supplied with two nozzles, these being sufficient to carry all the present load. After passing through the governing throttle valve, the steam enters the circular passage contained within the casing cover from which are the outlets that distribute the steam to the nozzles. The nozzles are of a curved section to fit the periphery of the wheel, a cross section through the steam jet at the outlet, being an approximate rectangle with rounded corners, the throat being of a circular section. The high pressure steam is contained within the circular passage, and is not in contact with the exterior of the turbine casing except where the controlling valves are situated.

Turbine Governor

The governor is of the centrifugal type with fly weights which act on a plunger, thereby transmitting the motion to a rocking lever mounted on the lower half of the governor casing, and through a lever and link to the throttle

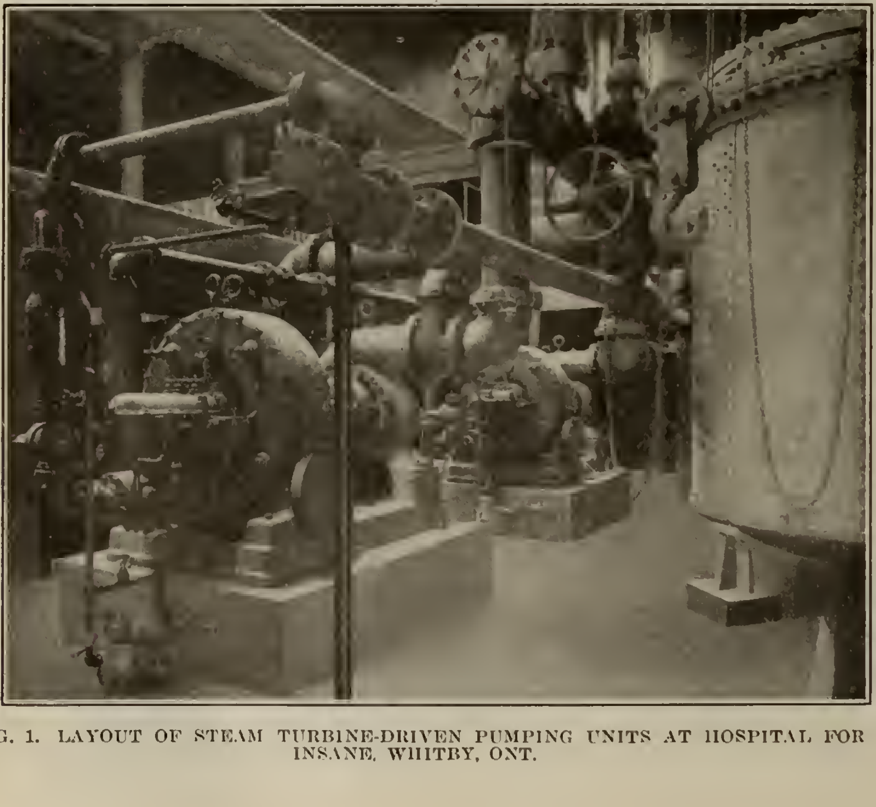

FIG. 1. LAYOUT OF STEAM TURBINE-DRIVEN PUMPING UNITS AT HOSPITAL FOR INSANE, WHITBY, ONT.

valve spindle. All of the joints where the principal forces occur are knife-edged to reduce friction. This makes the governor extremely sensitive. There are no oil cups on the turbine, the whole set being self-lubricating and automatic. In operation, these turbines have been run for several days without attention except to shut off the nozzle valves when the load decreased.

Overspeed Trip Device

Besides the main governor there is also an auxiliary overspeed trip device consisting of a ring which is slightly out of balance. This overpowers a spring in case of an emergency which would make the speed go higher than about 15 per cent. above the normal. When this ring flies out it operates a trip lever releasing the spring controlled butterfly valve, slowing down the turbine.

The stuffing boxes consist of carbon rings made in halves and held together by garter springs. Any leakage of steam which may get past the carbons is carried away by drain passages cast in the turbine casing. The carbons last several years before they need to be refitted. The Goldie & McCulloch Co. advise us that they have supplied turbines which have been in daily operation over five years, and in which the carbons have not required attention.

The turbine blades are of "extruded" bronze and are fastened to the wheel by means of milled slots, into which are inserted the shanks of the blades, two fitted pins being placed in each bucket. These pins are half in the wheel forging and half in the blade shank, and are all carefully peined over. On the outside diameter of the wheel blades there is a retaining band of nickel bronze fastened to and by the outer ends of the blades themselves.

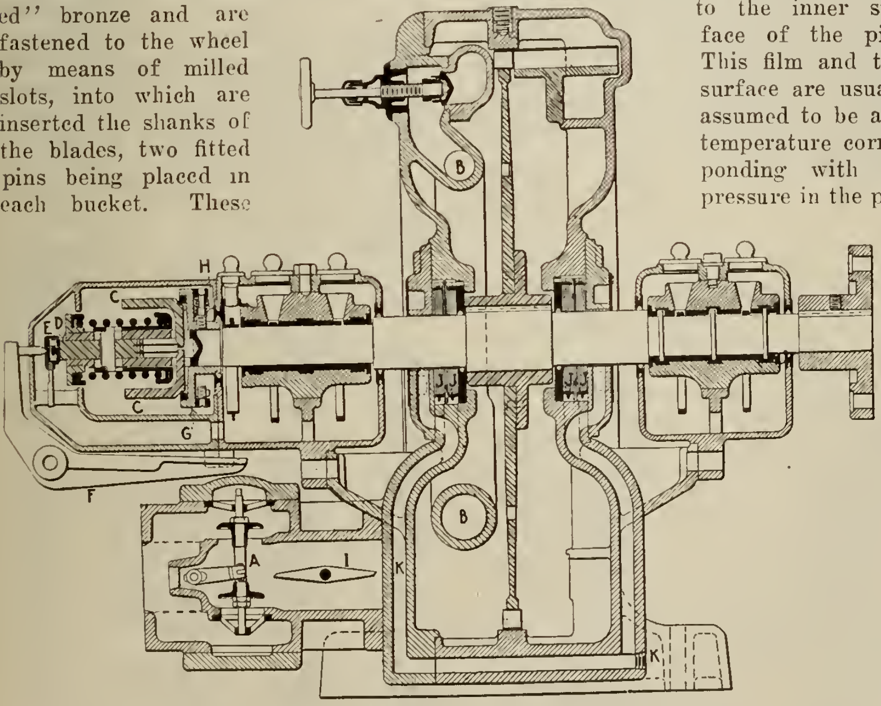

FIG. 2. CROSS SECTION THROUGH STEAM TURBINE.

After the wheel is completely assembled it is carefully balanced in a special machine for the purpose, after which it is run at such a speed that the strains due to centrifugal force will be approximately double those under normal operating conditions. After being tested overspeed it is again balanced, thus insuring a true running wheel.

The bearings are of the ring-oiled type, babbitt-lined, and in the larger sizes are water-cooled for speeds over 2,000 r.p.m. The shafts are of special steel and of sufficient size and strength to have a critical speed considerably above the normal so that the turbine will not have to pass through the critical speed when being started up.

* * *

HEAT LOSSES IN STEAM TRANSMISSION

THE question of heat losses by radiation and transmission between various substances has been the subject of considerable investigation by well-known scientists, and one phase of the question was recently dealt with in considerable detail by W. L. Cathcart in a paper read before the American Society of Naval Engineers, dealing with heat losses in steam transmission, which in part is as follows:

The action during the cooling of saturated steam is complex. Unless the velocity of the steam is sufficiently high, a film of moisture or condensate adheres to the inner surface of the pipe. This film and that surface are usually assumed to be at a temperature corresponding with the pressure in the pipe owing to the heat column of steam . The film, however, acts also as an insulator to heat conduction from the steam, since the conductivity of water is, according to Lord Rayleigh, but 1-115 that of iron. Further, between film and pipe, pipe and covering, and the covering and surrounding air, external conduction takes place, meeting resistance at these three pairs of contact surfaces.

These various increments of resistance to heat transmission are shown roughly in Fig. 1. Let Aa be this resistance at the middle of an uncovered steam column, from which heat is dissipated chiefly by radiation, but partially by conduction. Then, Bb will be the resistance at the contact surface between the steam column and the moist film. The low conductivity increases the resistance to Cc, external conduction into the pipe adds the increment cd, internal conduction through the pipe metal makes the aggregate resistance Ee, external conduction into the covering increases the resistance by the amount of ef, the passage through the covering raises the total to Gg, and external conduction to the surrounding air gives the final increment gh. The total resistance to heat transference from the middle of the column is then represented by Gh.

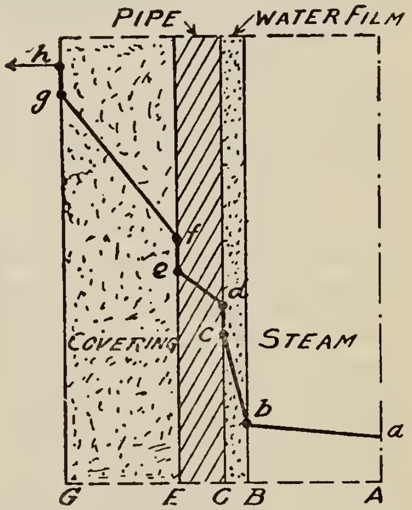

FIG. 1. HEAT TRANSMISSION RESISTANCE DIAGRAM.

Radiation and Conduction

Heat is transmitted from one body to another by conduction, radiation, or both. The fundamental difference between these two processes is that the former proceeds by the direct agency of matter—the contact or other action of one molecule upon another—while, in radiation, there is no connecting medium perceptible to the senses between a hot radiating body and the cooler ones which absorb its heat.

The two principal factors governing radiated energy are temperature difference and condition of radiating surface.

Regarding the former, investigations show that the higher relatively the absolute temperature of a radiating body the greater proportionately will be the amount of energy radiated.

The effect of the condition of radiating surface on the amount of heat radiated was investigated by C. L. Norton, who gives the total heat loss in

B.t.u. per square foot of pipe surface per minute as follows:

Condition of pipe surface.	Heat loss.
New pipe	11.96
Fair condition	13.84
Rusty and black	14.20
Cleaned with caustic potash inside and cut	13.85
Painted dull white	14.30
Painted glossy white	12.02
Cleaned with potash again	13.84
Coated with cylinder oil	13.90
Painted dull black	14.40
Painted glossy black	12.10

As conduction does not depend on the nature of the surface, the difference between these losses is due solely to the effect of the altered surface of the pipe on the amount of heat radiated. The temperature of these experiments was that corresponding to 200 pounds pressure.

Internal Conduction

The author states that the conductivity of air has been found to be 20,000 times less than that of copper, the latter being about 6.2 times that of iron. Superheated steam has low internal conductivity, and has been found to exist unchanged in the same space, for a considerable period, with saturated steam and the water of condensation.

This fact has an important bearing on the design of superheaters. It explains why efficient superheaters are composed of small tubes, or if large tubes are used, they should be fitted either with cores to form the steam into thin layers, or be provided with deflecting plates to rotate the steam and throw the heavier and colder particles against the hot tube.

The conductivity of a pipe-covering material can be greatly reduced, and its insulating properties increased by giving it a cellular structure, providing the air spaces are small enough to reduce air currents to a minimum so as to prevent loss by convection. Under these conditions, air-spaces act in two ways: they increase the conductivity by giving opportunity for heat transmission by radiation, and decrease it through the low conductivity of the contained air, the net effect of the two actions being a reduction. Asbestos by itself is a relatively good conductor; but its efficiency as a pipe covering is due to its cellular structure.

External Conduction

There is resistance to the flow of heat to or from any substance at its interface or joint with the emitting or receiving substance. This condition applies also to two parts of the same substance. If a rod be made of the same metal throughout, but in sections united by shrinkage fits or screw threads, there will be resistance to the passage of heat at every joint, and a solid rod of the same metal and dimensions will permit a freer flow of heat. The temperature at which a fusible plug melts is always lower than that of the plate in which it is placed, owing to the resistance offered to the passage of heat at the contact surface of the two metals.

As has been shown previously, the internal thermal resistance of a steam pipe is negligible, since the metal is capable of conducting more heat than it can absorb or emit. The reverse is the case with pipe coverings. Their primary characteristic is low internal conductivity, and hence they can receive and deliver more heat than they can conduct.

Rapid relative movement of the heat-delivering and heat-receiving surfaces increases the rate of heat transfer, because this movement keeps the temperature difference at its maximum. This is the principle which has been applied so successfully in the water tube boiler, and whose effects are marked also in the transmission of superheated steam.

HEAT LOSSES

(B.Th.U. per square foot per hour per 1 degree F. of temperature difference.)

Silver, polished	.027
Copper	.033
Tin	.044
Zinc, polished	.049
Brass	.053
Sheet lead	.133
Sheet iron, polished	.092
Sheet iron, ordinary	.568
Sheet iron, rusted	.689
Cast iron, new	.65
Cast iron, rusted	.689
Powdered charcoal	.701
Plaster	.738
Wood	.738
Cotton cloth (canvas)	.749
Woollen cloth	.754
Silk	.761
Oil paint	.761
Paper	.773
Lamp-black	.822
Water	1.089
Oil	1.484

The author discusses the formulae of various investigators based on experiments with covered and uncovered pipes and publishes numerous tables, two of which are reproduced as being of general interest.

CONDENSATE TESTS OF PIPE COVERINGS.

(Saturated Steam)

Investigator.	Pipe diameter.	Covering. Material.	Thickness	Temperature Air	Temperature Steam	Economy heat saved as compared with bare pipe, per cent.
	Inches		mm.	Degs.	Degs.	
Pasquay	....	Silk waste	26.00	15C.	135C.	85.6
Pasquay	....	Silk waste and air jacket	39.00	15C.	135C.	87.9
Brill	8	Hair felt	0.82	69F.	348.3F.	84.4
Brill	8	Mineral wool	1.3	58.3F.	344.1F.	81.4
Haacke	5	Kieselguhr*	1.0	76.1F.	307F.	83.6
Capper	....	Mica†	1.6	......	404.2F.	89.3
Barrus	10	Asbestos-sponge felt.	1⅜	62.8F.	364.8F.	91.3
Barrus	10	Magnesia	1 3-16	66F.	365.2F.	89.0
Barrus	10	Asbestos Navy brand	1¾	66.8F.	365.2F.	88.0
Jacobus	2	Remanit‡	1.3	76.1F.	306.6F.	86.9
Jacobus	2	Asbestocel	1.07	77.2F	301.8F.	77.2
Jacobus	2	Asbestos air cell	0.96	72.3F.	303.3F.	74.4
Jacobus	2	Asbestos fire felt	1.2	72.5F.	307.4F.	73.1
Jacobus	2	Magnesia	1.08	81.6F.	310.9F.	83.2
Bolan and Grieve	3	Slag wool	1.25	......	308.1F.	79.4
Bolan and Grieve	3	Magnesia, sectional	1.5	......	308.1F.	80.5
Zulauf	7.56	Snowdon's asbestos composition	2.28	83.3F.	366.0F.	89.2
Zulauf	7.56	Compr'd cork, Frick's	2.76	85.1F.	366F.	88.6
Zulauf	7.56	Isolgurit§	2.28	85.1F.	366F.	83.6

*Fossil meal composition.
†Made in flat or curved mattresses enclosed between casings of wire netting.
‡Braids or pads of carbonized silk; pads enclosed in a net work of fine wire.
§Infusorial earth with fibres.

In concluding, the author referred to a method of heat insulation, which has received less attention than it merits, which employs air jackets to encase the pipe with a film of air too thin for convection losses to be a serious factor. It is the entrapped air in their more or less cellular structure which produces the economy of most pipe-covering materials. With regard to air jackets of sheet tin or zinc, it is stated that at a steam pressure of one atmosphere the most favorable thickness of the air stratum or the distance between pipe and jacket should be about 15 mn., or ⅝ in. With such a distance, and a single jacket, the quantity of water of condensation was reduced 74 per cent., and with two jackets 85 per cent.

HEAT LOSSES OF SUPERHEATED STEAM IN BARE PIPES.

Computed for a steam velocity of 4,920 feet per minute and an air temperature of 68 degrees F.

Temperature, degrees F. of Steam	Temperature, degrees F. of Pipe	Temperature-difference between steam and Air	Temperature-difference between steam and Pipe	Heat loss per sq. foot of outer surface of pipe per hour, B.Th.U.
347	320.0	279	27.0	823
392	359.6	324	32.4	1,018
437	397.4	369	39.6	1,225
482	435.2	414	46.8	1,450
527	471.2	459	55.8	1,697
572	509.0	504	63.0	1,956
617	545.0	549	72.0	2,232
662	579.2	594	82.8	2,531
707	615.2	639	91.8	2,841
752	649.4	684	102.6	3,170

❖

Rope Strain Problem.—Regarding "Rope Strain Problem" in the February number of The Power House, the rope in Fig. 1 resists a strain of 200 pounds. A pull of 200 pounds at the loose end causes a reaction of equal amount at the wall or fixed end—see Newton's third law. In Fig. 2, the strain on the rope is the same exactly, the wall being simply replaced by a man pulling on that end of the rope.—K. T.

In all modern rules, the working load on wheel teeth is based primarily on the load necessary to produce fracture.

Light, Heat and Ventilation

DATA RELATIVE TO HEATING AND HEATING SYSTEMS—I.

By T. W. Reynolds*

HEATING and ventilating are relative to architectural achievement whether it concerns a dwelling, a public building, or a factory, and particularly so under Canadian climatic conditions generally, to some extent the one is the counterpart of the other, although most often, and especially in large establishments. separate provision is made. Data concerning heating and heating systems constitute the substance of this series of articles, and being diagrammatically illustrated, no difficulty should be experienced in following intelligently the various methods employed and deriving real profit as a result.

Definition of Terms

Direct heating is that method whereby the radiator is placed within the room to be heated.

Indirect heating is that method whereby the radiating surface is encased within a duct and air is caused to flow between and around the radiator sections by natural or mechanical means, thus conveying heated air into the room or rooms to be warmed.

A water line is the height at which the water will stand in the boiler or return, being slightly higher in the latter due to drop in pressure of the steam through friction in the mains.

A wet return is a return line of piping carried below the water line of the boiler.

A dry return is a return line of piping carried above the water line of the boiler. A dry return may be converted into a wet return by establishing a false water line or seal above the height of the water line in the boiler.

Flow pipes are those pipes carrying the heating medium from a boiler or furnace.

Return pipes are those pipes carrying the heating medium back to the boiler or furnace.

Such terms used in the following discussion are commonly found in works pertaining to heating or ventilating subjects.

General Pipe Work

The diagrams to be presented illustrate the relative location of various parts of the system described, but are not drawn to scale. The heaviest black lines show the larger sizes of the piping.

Radiators

The proper location for radiators is close to the coldest walls and under the windows where possible, and so arranged that all cold currents of air must first be warmed by these surfaces before striking the body. They should be set at a sufficient distance from the wall to allow a free circulation of air around them. The most efficient radiation is that whose surfaces are exposed to the coldest currents of air. More radiation should be placed on the northern or severest exposure than on the protected side. The diagrams show the radiators at an exaggerated distance from the wall.

The round upright cast iron boiler is the best for installations up to 1,200 sq. ft. of radiation. Above this amount use should be made of the rectangular cast iron sectional steam boiler. Cast iron will not as readily corrode as wrought iron or steel when standing idle in the summer months. It may also be easily molded into efficient cored waterways.

Fuel

Anthracite is the most desirable fuel because of its high carbon and hydrogen carbon content, small amount of ash, and lesser deposits of soot on fire and flue surfaces of the boiler. Bituminous coal requires a boiler one size larger.

The return pipe at the boiler should be fitted with a brass roundway plug cock with square head. The end should be left in sight as a direct connection to the sewer would fail to disclose any leakage due to defects or careless closing of the cock. A feed cock should be installed on the water supply line at a point convenient to the reading of the water gauge glass. If it is necessary to supply the boiler by hand, this should be done through the return pipe to the return connection. A stop cock should be installed on the pipe and end with a funnel approximately twelve inches above the water line of the boiler. It is advisable to install a check valve just below this to prevent the blowing out of the water should the stop cock be left open.

Air valves are either automatic or positive. The positive or compression air valve is hand operated and combines simplicity with a certain amount of radiator control as the valve may be closed before all of the air has been expelled. The effect is to partially heat the radiator. Cast iron fittings should be used throughout. As they are less elastic and of a harder metal than the pipe, they will not as readily leak when connections are made.

In general the steam main in a steam heating apparatus is carried as high as possible in the basement or cellar and is then pitched downward away from the boiler. This is done to prevent the condensation from flowing in an opposite direction to the steam. Only where the pipes do not exceed twenty or thirty feet in length should the steam and condensation be allowed to flow in opposite directions. In such cases the pipes should be made slightly larger with drips at a number of points. The pitch of the pipes should also be increased.

Water Hammer

When the pipes are long, there results a large quantity of condensation which becomes enough cooler than the temperature of the steam to cause the latter to condense quickly. This condition causes hammering in the steam pipes which may be likened to the beating of a sledge hammer upon some metal surface. Steam rapidly condenses when in contact with cold surfaces, the resulting vacuum inducing a rapid flow of more steam which slams the condensed steam (water) against elbows, valves, bends, etc., with terrific force. The volume of steam at atmospheric pressure is 1,644 times greater than when condensed to water.

Steam condensing in contact with cold water creates severe concussions as the two bodies of water come together, therefore slow admission of the steam to cold pipes or to those which hold some water is advisable. The harm done by this hammering is in some cases very severe. It loosens the threaded joints, bursts fittings or pipes, and otherwise causes a great deal of annoyance. An enlargement of the main steam pipe at the boiler or a separator made up of fittings is very effective in preventing the entrained water in the steam from being carried through the pipes and causing water hammer.

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*MacMullen, Riley & Durley, Toronto.

The main supply pipes must be carried around the basement in such a manner that windows or doors are cleared and that proper head room is provided in passageways and rooms. It is advisable to keep the main supply pipe at least four feet from the outside walls. This provides for expansion in the risers without placing excessive strain upon the fittings and threads. The coldest portion of the building (which happens to be the northwest in this latitude) should always be supplied most directly by the mains and should receive preference in every way possible.

System Provisions

In general, the system must be proportioned for the worst possible conditions, such as excessive steam demand in certain rooms, open windows, loosely fitting doors and windows, poor construction and shrinkage, buildings so constructed that air freely circulates between studding and crosswise through ceilings, air bound radiators, stoppages due to short bends and valves, variations in pressure or water temperature, poor coal or poor firing, a fire requiring too frequent attention, improper firing periods, unclean fire, a fire pot too full, ash pit seldom emptied, poor draught, insufficient radiation or boiler capacity, dirty or rusty air valves, trapped riser connections, which may have been depressed by the gas fitters or by others, loose valve seats, poor condition of chimney, accumulation of oil, grease or grit in the system, a poorly designed installation due to unreasonable demands of the owner, radiators used as clothes driers, supports for statuary or in other ways preventing contact with a free circulation of air, also many other faulty arrangements or methods of operation liable to occur.

Return Pipe Sizes

The return pipes must in all cases be of ample size to carry the water of condensation. They should be run below the main in which the steam flows. A wet return can be of smaller size than a dry return, as it is entirely filled with water at all times, steam naturally having a larger volume than when condensed. A dry return should never be less than 18 in. above the water line of the boiler, preferably 3 ft., as this permits a greater reduction in pressure. The return pipes should always pitch toward the boiler. Where traps are used to return the water to the boiler, the return line should be graded in the direction of the low trap. It is always best to put a horizontal swing check valve on the return line near the boiler of any steam plant to keep the water line of the boiler steady. It also serves as an automatic stop valve should the main steam valve be accidently closed. When two or more returns are connected together, the connection must always be below the water line of the boiler. This prevents the flow of steam from more than one direction. Pressure decreases in accordance with the distance from the boiler and friction surface encountered, steam tending to flow through the line of least resistance to the place of lowest pressure.

The size of supply mains should not be reduced too rapidly as the branches are taken off. Friction is much greater in proportion in the smaller sizes of pipes, the ratio of friction surface to volume increasing rapidly. An installation will produce better results if all pipes are one or two sizes large, but very unsatisfactorily, if at all, when they are undersize. Pipe smaller than ¾ inches should not be used, either as supply or return pipes, for allowance must be made in figuring the cross area of pipe required for certain practical conditions, such as inside pipe corrosion, good drainage, pockets, sagging of pipe, mechanical injury, etc. As a general rule valves are not necessary on the mains. They only serve to increase the first cost and maintenance.

Pipe Expansion and Contraction

Broken joints and leaks result from the expansion and contraction of pipes, so that it is very essential to provide for this, likewise to see that all pipes have the proper alignment and that no traps or pockets are allowed to form where reductions are made (eccentric fittings may be used or lines dripped at such points) or any other pockets caused by the sagging of the pipes. Pipes should be held firmly in place and prevented from sagging by using substantial hangers. The expansion of risers if not properly provided for will form pockets at their connections to runouts from the main.

There are several methods or devices designed to properly take care of expansion. Those in most common use, are, the swing joint which is a connection made up of four or more elbows; the U shaped pipe bend which takes care of the lengthing or shortening of the line in the "spring" of the bend; the patented slip expansion joints which are made in both the packless and the stuffing-box type; and the diaphragm joint which depends upon the flexibility of a thin metal corrugation or bellows usually made of copper. All piping systems should be designed so that the least possible strain is brought to bear upon fittings in the lines.

Type of Building Consideration

Piping installations in fire proof buildings may differ from those in frame structures. In many modern buildings (whether fire proof or not) it is desirable to conceal the pipe work. This may be effected if chases of ample size are provided, allowing for the free swing of all pipes and joints when they expand or contract. All piping concealed in chases should be insulated with pipe covering to prevent an excessive loss of heat through the walls (where these are outside walls) and to prevent cracking of the plaster. All piping in the cellar should also be covered, as more or less heat is lost through even the best pipe covering, and this amount is usually sufficient to warm the cellar to above freezing temperatures. In figuring the necessary boiler capacity required, all mains and branches should be connected as radiating surface unless thoroughly covered with a good heat insulator.

Globe valves offer considerable resistance to the flow of water in pipes and should for this reason never be installed in hot water heating systems. If used in steam plants they should never be set vertically on a horizontal pipe, otherwise the free drainage of the pipe is impeded, and the condensation retained until the cross area of the pipe is practically filled. This is due to the interior projecting web or diaphram which forms an integral part of a globe valve.

GRAPHITE AS A LUBRICANT

THE benefits to be derived from the use of graphite as a lubricant are more widely recognized perhaps in this continent than in any other. As prepared in the electric furnace, graphite is produced in a state of extremely fine division, and is marketed in the form of a thick paste or grease which is added to lubricating oil in very small percentages.

According to recent tests caried out by Aaston, a proportion of 0.35 per cent. of graphite gives the best results, although mixtures have been used successfully which contained from 0.1 per cent. to 0.5 per cent. The effect of this small amount of material, in reducing the co-efficient of friction between bearing surfaces, and in maintaining cool running with irregular supplies of lubricant, is truly remarkable.

Tests showed that no appreciable increase in bearing resistance occurred when the oil supply was reduced from 8 drops per min. to 1 drop per 2 min. The theory is advanced in explanation of this extraordinary efficiency that the graphite is in such a fine state of division that it is capable of actually entering the pores of the metal, or so depositing itself between the minute projections which exist even on highly polished surfaces, that it forms what is practically an anti-friction amalgam which remains in position despite the absence of liquid lubricant, or the existence of excessive bearing pressures.

POWER PLANT FEATURE IN A MUNITION FACTORY

MUCH of the disquietude—not yet entirely at an end, in connection with the production of a sufficient supply of shell — shrapnel and high explosive, has been due, says Engineering, to an inadequate knowledge on the part of laymen as to the extent of the plant necessary for producing shells, and the number of operations and high degree of accuracy involved in their manufacture.

The shop illustrated, one of Britain's new projectile making factories, embraces 10 acres under the glass roof, and is one of many now in full operation, turning out thousands of shells per day. Others are being as rapidly brought to the same state of efficient production. There are nine bays of an average length of 370 ft., with a total floor space of 196,600 sq. ft. Two of them are arranged as press shops for the forging of bars into shell cylinders—either shrapnel or high explosive type, and ranging in diameter from the smallest to the largest required.

In the power station, the hydraulic accumulators are prominent. The principal feature is the installation of pumps for supplying water to the presses for forging the bars into shell cylinders. There are nine of these, each working up to 1,500 lb. pressure per sq. in. They are steam-driven and the aggregate power developed under ordinary working conditions is about 3,000 horse-power. These pumps deliver to two accumulators, 26 in. in diameter by 20 ft. stroke, and the supply of pressure water is controlled by electrical and mechanical devices, which come into action as the accumulator approaches the top of its stroke.

For hydraulic pressures of 4,480 lbs. per sq. in., there are three horizontal pumps, developing 510 horse-power, delivering into a pair of accumulators, 15 in. in diameter by 16 ft. 6 in. stroke, and similarly controlled. Steam is supplied by four water-tube and five Lancashire type boilers, all fitted with mechanical stokers. Two of the water-tube boilers are of Stirling type, and two of Babcock & Wilcox design, all being fitted with chain-grate stokers and induced-draught fans. The boilers are fed with town water by vertical feed pumps. Electrical and pneumatic power is supplied from a separate central station.

POWER STATION AND MAIN BUILDINGS OF A BRITISH PROJECTILE-MAKING PLANT.

ROPE-DRIVING FLYWHEELS

ROPE-DRIVING flywheels are very similar to those for belt-driving, but the rims are prepared with grooves to grip the ropes. The width necessary for a given power is less than with belts. Ropes possess more elasticity than belts and involve less loss by secondary tension, the total tension upon the driving side being about six times as great as that upon the slack side.

The driving power is gained by frictional resistance to slip, which in this case is exercised in duplicate upon the two opposing sides of the grooves. Some increase in loss of power is involved by reason of the force required to bed the ropes in the grooves and to withdraw them upon the leaving side.

Rope Grooves.—The majority of rope grooves are made with the two sides set an angle of 40 degrees, so far as contact is, or may be, made with the rope. The bottom of the groove is rounded out sufficiently to escape contact with a rope, however much its diameter may be reduced by wear and stretching. The upper parts of the two sides are set nearly parallel. Cotton ropes will work on 40 degree or 45 degree grooves, but Manila ropes on 45 degrees are liable to slip. Grooves with curved sides are equivalent to a variable angle to suit reduction of diameter of ropes by wear.

Convergence of ropes, as in belts, affects the driving power.

Splicing of Ropes.—Ropes should be spliced when free from rotative tendency, and suitable precautions taken to conform with the methods adopted in the makers' works.

Deflection of Ropes.—A fully loaded rope will sag or become deflected below a straight line by an amount, in feet =

$$\frac{(\text{Free length in feet})^2}{70}$$

Uniformity of Grooves.—It is most important that all the grooves in one set should be made precisely equal in regard to width, angle, and condition of surface, otherwise the ropes are liable to wear unequally and slip excessively.

EXTERNAL VIEW OF ONE OF BRITAIN'S NEW PROJECTILE-MAKING PLANTS.

Power Transmission Section

CAST STEEL GEARING

By T. E. C. H.

THE efficient design of gearing has undoubtedly met with its due share of attention, but most articles the writer has seen have dealt more with the shape and strength of the teeth than with the design of the body of the wheel itself. The following may not therefore be out of place as an attempt to consider wheel body design in the case of cast steel gearing.

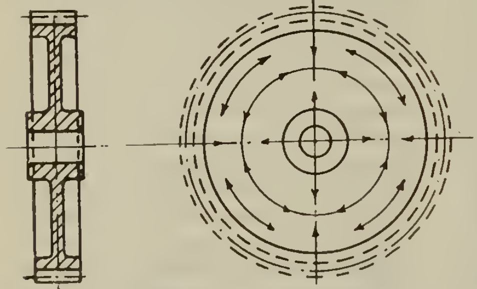


FIG. 1. DISC WHEEL SHOWING STRAINS SET UP WHEN METAL COOLS DOWN AFTER CASTING.

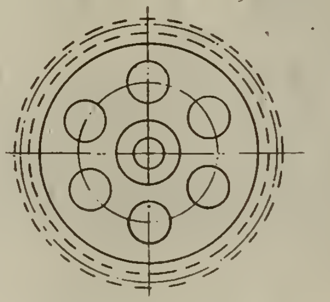


FIG. 2. DISC WHEEL WITH HOLES TO RELIEVE STRAINS DUE TO COOLING AFTER CASTING.

Disc Wheels

These are now very seldom employed over two feet diameter, and although of the simplest design, it is not uncommon to find the holes in the web left out, these holes being essential to enable the metal to contract in cooling without leaving a permanent strain. See Figs. 1 and 2. When the rim is rather wide, small webs connecting it and the boss to the web are also advisable, and help when pouring the metal, but for appearance some designers prefer to leave them out.

Arms

The cross or star shape arm for cast steel wheels seems to be passing away, and although to many the appearance is good, the difficulty of obtaining clean castings in steel without extra trouble tells against it.

H. Section Arms

This design of arm is now the rule, and the question designers have to ask themselves is not what kind of arm, but how many, and what are the thicknesses. The following rules are suggested:

A—With teeth below thirty in number and of large pitch there generally arises no question of strength of arms. These being, when made the minimum thickness permissible for casting purposes, many times of greater strength than that required to take the load.

B—With teeth above thirty in number and of large pitch, then by dividing the load by the number of arms and assuming that the rim acts as a rigid strut between the arms, the bending moment to be resisted by one arm can be obtained, and the strength of the arm checked. To obtain a greater strength of rim, so as to ensure that the assumption holds true, that the rim will act as a rigid strut, and also to offer a greater resistance to bending when the pinion is engaging with the teeth between the arms, the under web of the rim is increased in depth at the centre as shewn by the arrow marks in Fig. 3. This by many is, however, not considered to give a neat appearance.

C—In the case of teeth being above fifty in number and of large pitch, it should be noted that with every increase in number of teeth the assumption that the rim can act as a strut does not hold, and thus the strength of the arm must be determined by the bending moment which one arm must resist, the load being that on each tooth.

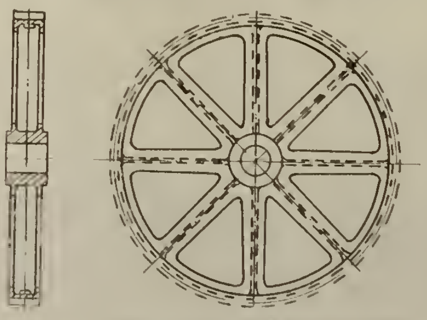


FIG. 3. CAST STEEL WHEEL WITH H-SECTION ARMS.

Number of Arms

This should depend upon whether the wheel is to have machine cut or cast teeth. When cast as a blank with the rim more than twice the final thickness, it is advisable to make the arms fewer in number, but of slightly greater thickness for casting purposes; a compromise, however, is necessary, or else, after the teeth are cut, the arms would be a great deal stronger than the rim. By increasing the thickness of the web under the rim this difficulty is overcome.

Sections of H. Arm

The webs of the arms are now being made thinner than the flanges, this enables the metal where the rim joins the arm to contract easily. In a large wheel, a space is left between the arm web and the rim for this purpose, as shown in the section rim, Fig. 3. Besides helping cooling, the weight of the wheel is not only reduced by this design, but its strength is at the same time increased by so doing. For instance no structural engineer would increase the thickness of the web of a girder to increase its strength, yet even to-day in many of the designs of gear wheel the web is very often twice the necessary thickness.

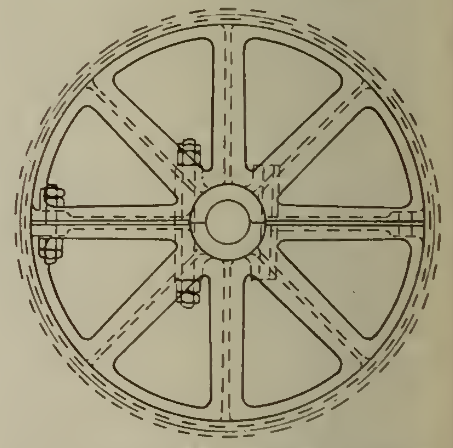


FIG. 4. SPLIT GEAR WHEEL SHOWING BOLTS PASSING THROUGH WEB OF ARMS.

Split Wheels

The question of easy access to the clamping bolts of split wheels is now receiving its due share of attention, and the bolts near the hub which have been the greatest offenders in this respect can easily be made to pass through the web of the arms, as shown in Fig. 4. Only with wheels for high speed duty with very wide faces and small pitches do the rings shrunk on the boss seem to be favored. The bolts near the rim are often staggered to ensure greater ease in assembly, and it is now very seldom that they have to be tightened up by the old method of knocking the nuts round with hammer and chisel.—Herbert's Monthly.

* * *

CHART FOR CONVEYOR BELT CALCULATIONS

By J. D. Mooney and B. L. Darnell

THE acompanying chart has been drawn for the convenience of engineers as a means of quickly determining the correct number of plies of conveyor belts operating under specific conditions. The calculations are based on the average safe strength with a factor of safety of 15, of the various standard rubber conveyor belts. The calculations assume maximum loading conditions; that is, the belt is considered as carrying the greatest load that it will handle without spillage at ordinary belt speeds. This not only produces the most economical operating conditions, but also the maximum tension in the belt.

The chart is a graphical representation of the formula where:

$p = kgW\ (L+10H)$

p = the correct number of plies

k = a constant depending on the type of drive

g = the weight in pounds per cubic foot of material handled

W = the width of the belt in inches

L = the length of the belt in feet

H = the difference in elevation between the head and tail pulleys, in feet.

For a simple drive, with a bare pulley,

$$k = \frac{1}{250{,}000}$$

For a simple drive, with a rubber-lagged pulley, $k = \dfrac{1}{300{,}000}$

For a tandem drive, with bare pulleys

$$k = \frac{1}{375{,}000}$$

For a tandem drive, with rubber-lagged pulleys, $k = \dfrac{1}{455{,}000}$

The chart is drawn for a simple drive, with a bare pulley, therefore, the number of plies obtained from the chart should be multiplied by the factor 0.83 or 5/6 for simple, lagged drive; the factor 0.67 or 2/3 for tandem, bare; and the factor 0.55 or 11/20, for tandem, lagged.

The formula $p = kgW\ (L+10H)$ has been developed mathematically from the following formulae, which have been found to work very satisfactorily in average good practice:

$$U = \frac{0.08W^2Sg}{5{,}000}$$

$$HP = \left(\frac{0.021}{200} + \frac{0.01H}{10}\right) U$$

$$T = \frac{C \times HP \times 100}{S}$$

$$p = \frac{T}{24W}$$

Where—

U=Capacity in tons per hour

W = Width of belt in inches

S = Belt speed in feet per minute

g = Weight per cubic foot of material handled

HP = Horsepower developed in driving conveyor belt

l = Length of the conveyor, in feet (approximately ½ L)

H = The difference in elevation between the head and tail pulleys, in feet

T = The total tension in the belt, in pounds.

p = Correct number of plies

C = The constant of the drive.

For a simple drive, bare pulley $C = 600$

For a simple drive, rubber-lagged pulley $C = 500$

For a tandem drive, bare pulley $C = 400$

For a tandem drive, rubber-lagged pulleys $C = 330$

The length factor, $f = (L+10H)$, represented on the chart by the lines 500, 600, 700, etc., is a developed factor equal to the sum of the length of the belt and ten times the difference in elevation between the head and tail pulleys. To find the correct number of plies for a conveyor belt, knowing the width, the length, the difference in elevation between the head and tail ends, and the kind of material to be handled:

Start from the width given at the top of the chart and move down until this line intersects the line corresponding to the proper length factor; then move either right or left until the line corresponding to the given material is met; then move down again to the scale of plies, where the next largest figure will give the correct number of plies.

For example:—To find the correct number of plies for a conveyor belt 36 inches wide and 300 feet long, with 20 feet difference in elevation; handling sand and gravel: Follow the line from the 36-inch width downward until it intersects the 500 length factor line; then follow to the right until the sand and gravel line is intersected; then down to the ply scale, where the ply will be found to be seven.

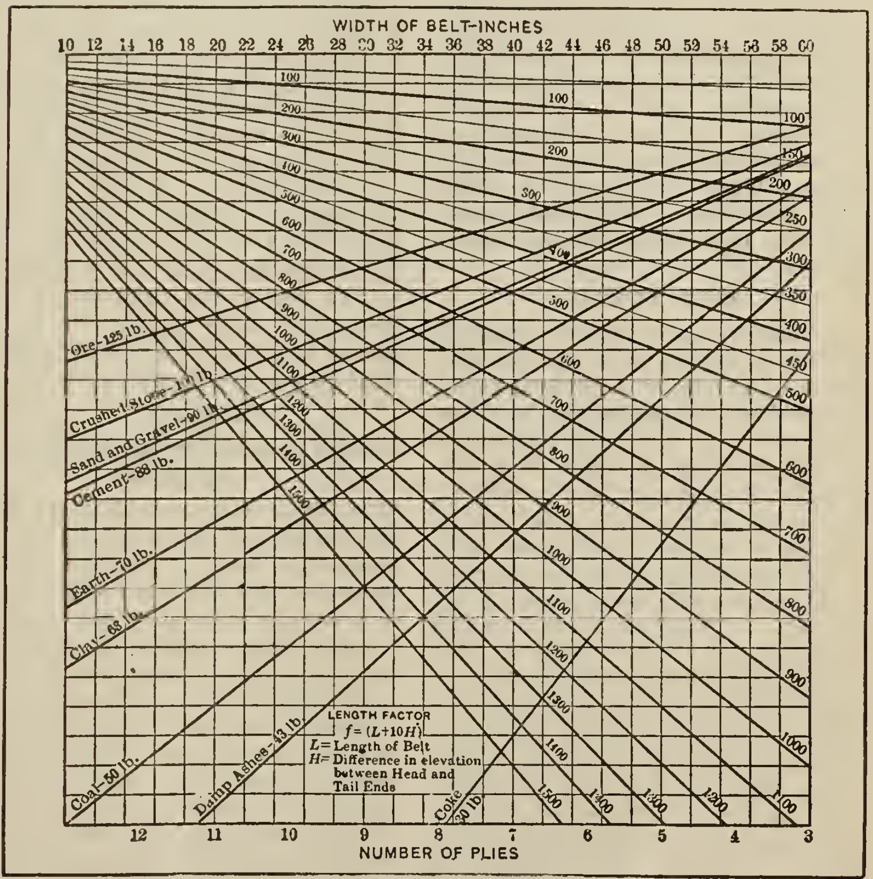


CHART FOR CONVEYOR BELT CALCULATIONS.

Electricity and Hydraulics

MODERN DEVELOPMENT OF WATER POWER

AT a recent meeting of the Society of engineers (Incorporated), a paper was read in which it was stated that the modern development of water power, mainly due to the extensive use of electrical energy for a variety of purposes, had brought about a complete change in the construction and size of water turbines, the latter now being in service, up to quite as much as 20,000 b.h.p. The total capital invested in hydraulic power undertakings was now probably over $2,500,000,000.

The available power in Great Britain was variously estimated at from 500,000 to 1,000,000 horse power. To develop that power by steam would require 2,410,000 tons of coal per annum, and the value of that coal at, say, $2.50 per ton would represent the interest at 5 per cent. on a capital of $120,500,000.

Water power was, to a certain extent, dependent on meteorological and topographical conditions, and a certain regularity might be obtained by afforestation and by storage, such as was provided for irrigation purposes. Schemes were now being carried out or contemplated to make large, swift rivers navigable and to create large power plants destined to form industrial centres in the future.

Water Turbines

Turbines were, the author remarked, the most efficient of water motors, being classified into impulse turbines and pressure turbines, and represented by Pelton wheels and Francis turbines respectively, various types of which were described. The selection of a turbine did not depend on the fall alone, and in selecting a turbine the efficiency under varying conditions should be carefully considered, as efficiency represented capital value. The falls so far utilised ranged from 2 ft. up to 5,000 ft., and a Pelton wheel was described utilizing a fall of 2,800 ft. The governing of turbines had been completely revolutionised owing to the requirements for generating electricity, and had been brought to a high state of perfection. The prompt action of the modern hydraulic governor called for special devices for the protection of pipe lines against bursting owing to water-hammer, and an ingenious mechanism was shown whereby that danger was prevented without any waste of water.

Power Cost

The paper further dealt with the cost of power. Not the capital outlay, but the annual expense of a power-generating plant should be the deciding factor. A comparison of the annual costs of various sources of power was given, shown that these costs were less in the case of a water-power plant, even if the capital expenditure on it had been greater than that of a steam plant of the same power. With a good load-factor, a larger capital outlay for a water-power plant was admissible, and such plants with auxiliary steam power to make up for shortness of the water supply in the dry season were remunerative.

Water power had become of such importance in recent years that a State monopoly had been considered in some countries. Some protection against injudicious use of water for the purpose to the detriment of others was necessary in order to facilitate the development of water-power where it benefited the population of a district. The purchaser of a turbine should ask for a definite guarantee of efficiency of the turbine he proposed to buy, not of the power, and, where the conditions of water supply varied, of the efficiency under a diminished water supply. The paper showed how the claims should be formulated to prevent disputes or lawsuits.

* * *

SEALING-UP HOLES IN TRANSFORMERS

IT is often necessary to seal up holes in transformer or oil-switch cases where wires pass through. Probably the most commonly used material for this purpose is a mixture of sulphur and plaster of Paris. Either material used by itself may answer the purpose in some cases, but if the two are mixed half and half it gives a very hard substance when it has set, and one that is impervious to transformer oil. The sulphur should be melted in a ladle or pot and then an equal quantity of plaster of Paris mixed thoroughly into it. This mixture should be poured into place while hot.

Trouble is often experienced from oil being syphoned out of transformer cases on account of the braided insulation on the lead wires. When this takes place it is usually found that the insulation on the wire dips down into the oil. If the oil level is lowered below the terminal board inside the case and the insulation on the leads scraped off so that where the wire enters the surface of the oil its metallic surface only is exposed to possible contact with the oil and the leads are properly sealed, there will be little trouble due to syphon action.

* * *

VENTILATION OF LARGE ELECTRIC GENERATORS

THE output of modern turbo-generators has become so great, and the over-all dimensions of these machines have become so small that, despite continual increases in efficiency, the actual amount of heat generated within a small space by copper and iron losses has increased alarmingly, and the problem of removing this heat sufficiently rapidly to prevent injurious temperature rise has become acute. Forced ventilation is almost invariably employed in such machines, and its provision has added to the equipment of modern generating stations, large blowers, and extensive air conduit networks.

For obvious reasons, air used for forced ventilation should be drawn from outside the power house; but even then it frequently contains an appreciable percentage of dust, which, if allowed to reach the generator windings, would there accumulate, reducing the efficacy of cooling, abraiding the insulating material, and rendering the latter more or less hygroscopic.

The most generally adopted means of eliminating dust from air to be used in ventilating machines consists in passing the air through linen filter sheets mounted in wooden frames. Unfortunately, such filters occupy considerable space, require frequent cleaning, and are subject to heavy depreciation. Further, their use increases appreciably the risk of disastrous fire, and, when used, they should certainly be mounted at such distance from the generator windings that flames from them cannot be blown into the windings. A safety door normally suspended by a fusible link should be used as an additional safeguard.

According to an English contemporary (The Power User), several important installations have recently been laid down in that country in which air for ventilating turbo-generators is filtered by passage through a "curtain" of water falling as fine rain. The filter comprises a horizontal conduit of galvanized sheet steel, and of large diameter, so that the air velocity may here be comparatively low. At the centre is mounted a system of narrow nozzles, very close together and so inclined as to project fine streams of water against the incoming air current. Owing to the fineness of the jets and the opposition of the air, the water forms a very effective mist-filter. Before reaching the blower, the filtered air is passed through a separator, in which mechanically suspended particles of water are deposited. Though the air is practically or quite saturated when it leaves the filter, it is not saturated at the temperature of the generator windings, and in practice no injurious results can be traced to the moisture of the cleansed air. A centrifugal pump is used to circulate water from a sump well through the filter nozzles.

The total space occupied by the equipment is small, cleaning is easily and rapidly effected, and the upkeep charges are low. For plants of 5,000 kw. or greater capacity, the water filter is cheaper than the linen sheet type, and in any case the fire risk of the latter is eliminated and the resistance offered to air flow is reduced.

ELECTRICAL ACCIDENTS IN ENGLAND

THE annual report of His Majesty's Electrical Inspector of Factories for the year 1914, has just been published in England, and besides the usual review and tabulation of the year's events, it gives considerable detail information regarding the more important accidents.

A reduction of 16 per cent. in the number of accidents occurring in factories other than electrical stations, etc., is shown compared with the year 1913, the number being 350 against 418.

The various accidents and their causes are given as under, the figures in brackets indicating fatal accidents:

Portable apparatus, connectors and flexible wires	65	(2)
Miscellaneous accidents in electrical manufacturing and repair works — mostly in testing operations	55	(1)
Working on live electrical apparatus or conductors—unskilled persons	46	(2)
Working on live electrical apparatus or conductors — skilled persons	42	(1)
Arcing of switches	38	...
Unprotected conductors, switches, terminals, fuses, etc.	36	(7)
Miscellaneous	31	(3)
Shocks or burns when replacing fuse wires	22	...
Arcing of fuses	9	...
Adjusting brushes and cleaning commutators, and flashing at commutators	6	...

The most frequent cause of accidents is again seen to be "portable apparatus." Twenty-six of the accidents due to this cause were occasioned by handling the flexible conductor. The report emphasizes the fact that proper examination of flexible conductors is unknown in many works, and a fruitful source of trouble constantly exists in worn out and damaged "flexibles." Various types of armouring come in for criticism, the spiral wire, and wire wove braiding being condemned, while whipcord braiding is recommended. The liability of the two former types of protector to penetrate the cord when damaged, and thus short circuit the entire sheathing, is pointed out as an objectionable feature.

In six cases accidents were caused through adapters being used in lamp sockets and connected with another lamp socket by common twin flexible cord, the connection with the movable lamp socket being carelessly made so that it became live unexpectedly. If the lamp holder cannot be earthed conveniently it should at least be insulated so that moist hands and floors may not form such death traps to unsuspecting workers.

The Dangers of Inexperience

The employment of apprentices and pupils on testing work is considered responsible for the numerous accidents in electrical factories. This work requires a degree of skill and experience which cannot be expected in beginners, and this fact, coupled with the use of equipment of a makeshift nature, contributes largely to these regrettable occurences.

One of the fatal accidents in "miscellaneous," was the outcome of conditions which exist in many workshops to-day and the danger is not realized till too late. It occurred in connection with a "fool-proof" fuse box where the fuses cannot be touched until the switch is off. This apparatus was made for using cartridge type fuses, but these had been replaced by ordinary fuse wire. One end of a fuse had been disconnected for some reason or another, and the box closed. The electrician was not aware that the loose end of the fuse wire was in contact with the box and when he closed the switch some time later he received a fatal shock from the iron case.

ARMATURE KEY TROUBLE

A 100-KILOWATT direct-connected exciter set soon after erection developed a slight knock which the operators were unable to stop. It ran about four years with the sound gradually getting worse, and the operators were sure that the trouble was in the armature, which was keyed solidly on the shaft, but which gradually seemed to be getting out of balance. Finally the risers from the commutator to the armature coils began to break. The commutator was then removed from the shaft, and the trouble found out. The armature was fitted with the usual cast iron spider with all the laminations keyed to it with one key. The laminations were too large for the spider and had been improperly keyed on, allowing them to work backwards and forwards on the key, thus causing the knock and finally crystallizing the risers. A new key was fitted, and the set is running quietly.

READERS' QUERIES

1—Is a pound of water evaporated at any pressure, also a pound of steam; if not, what is a pound of steam? We say that a particular engine uses 30 pounds of steam per horse-power per hour, do we mean that 30 pounds of water in the form of steam are consumed per horse-power per hour?

2—Is an injector more economical than a pump, if the exhaust from the latter goes to waste?

3—Is an injector liable to put air into the boiler from a leaky suction, and will that air be a hindrance or drawback to a condensing engine?

4—If water be put into a boiler at night and the fire be banked to prevent steam blowing off at the safety valves, and if all other connections are steam tight and no water leaks out, will there be as much water in the boiler next morning, with the steam gauge showing the same pressure as it did the night before?

5—If a boiler be filled with water so that all the contained air is forced out, and if steam be next generated and afterwards condensed in a perfectly air-tight condenser, will air be found in the condenser? If so, how did it get there, and, if it comes from the water, is the latter heavier per cub. foot than before?—C. F. K.

I am operating a steam plant but find it almost impossible to keep the boiler from foaming. The boiler feed water is drawn from a deep well bottomed on rock. The water is clear, little sediment or matter in suspension being apparent. The boiler is an old-fashioned affair. Suggestions as to preventing the foaming trouble are requested.—Service.

REFRIGERATION DEPARTMENT

PIPE LINE INSULATION*

By C. E. Matteson

TOO many things have been said regarding insulation that did not bring home to owners and operators the facts in dollars and cents as regards their losses through uninsulated surfaces. They fail to remember the steam pipe running from the steam main to some little brine pump or steam engine, or a steam line running to the can dipping tank away back in the tank room or perhaps an ammonia or brine line which is uncovered. If you have uncovered heated pipes, no matter what insulation you put on it will be a high paying investment. The maximum paying investment will, however, be determined by the wisdom of your decision as to what particular type of material is applied and the thickness, and also the carefulness with which the work is done. No set hard and fast rule can be given offhand as to what material is the best, since this must be determined by the temperature and other conditions.

For hot water lines, and temperatures around 212°, the cheaper grades of covering may be used, but many of these lines are placed in locations where considerable injury can be done to the covering. It is also well to standardize on a grade of covering which will be suitable for any service.

Many of the boilers installed are return-tubular or marine type, and a customary method, and one which gives good insulation results, at a low cost, is the use of three inches of asbestos cement properly applied, re-enforced with chicken netting.

Cold Water Line Insulation

Many operators of ice plants consider that an ice water line is not cold enough to require insulation. A practical illustration of the necessity for insulating these lines may be had in the fact that three-fourths of the refrigerating work on the average ice water drinking system is represented by the loss not of bare pipes but on insulated pipes, the remaining one-fourth of the work done by the refrigerating machine being represented by the water which is consumed. Furthermore, an exposed cold water line constantly condenses moisture, causing the pipe to rust rapidly, often requiring early renewal and producing a sloppy line directly under the pipe which gives the plant a most insanitary appearance. To insulate cold water lines, we recommend the use of wool felt covering which is especially designed for this type of service, consisting of alternate layers of wool felt and water-proofing fabric thereby making it moisture-proof as well as a good insulator. This type of covering can be taken off and reapplied without injury.

The most difficult surfaces to insulate are cold brine and ammonia piping. Not only is the proper material required but we cannot emphasize too strongly the carefulness with which it must be applied. After advocating and using several kinds of construction and materials for this service during numerous years of experience, we favor the use of two or three layers of 1-inch hair felt properly applied and properly protected, the thickness depending upon the temperature inside and outside of the covering. We recommend first, the application of a layer of sheathing with edges well lapped and well cemented together around which a layer of 1-inch hairfelt is wrapped, followed by a layer of sheathing of 1-inch hairfelt and then another layer of sheathing well cemented, and so on as additional thicknesses are required on account of conditions.

* * *

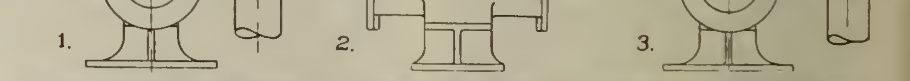
Correction.—In the article entitled "Testing Armature Faults," which appeared on page 37 of our February issue, the sentence beginning three lines from the bottom of page—first column, should read: Bars P and Q and S and T show no deflection ,etc.

BRINE PUMP POUNDING

By T. J. Rogers

THERE is, among a number of refrigerating engineers, a certain pet theory which has been proven to the writer's entire satisfaction, to be wrong a large number of times. Engineers are frequently troubled by the brine pump pounding, especially on what are known as "gravity return systems," and in the majority of cases they lay the blame to the fact that there is no air in the discharge air chamber. They shut the pump down and spend, or I might say waste, considerable time charging this chamber with air. True, the pound is relieved, but by no means permanently, and, on its return, the foregoing operation is again performed, or else the machine is allowed to run along with the pound and consequent shock and jar.

Now while the above described condition certainly would cause a pump to pound, not one time in a hundred is it the cause of the pounding in the brine pump, when such exists.



ARRANGEMENTS WHEREBY POUNDING IN BRINE PUMPS MAY BE OBVIATED.

The real cause may be stated as follows:—

After the brine has passed through the coolers, etc., it falls back to the brine tank and enters same under the pressure caused by the drop. This drop is usally four or five storeys and assuming twenty feet to the storey, the vertical distance would be eighty or 100 feet. To find the approximate pressure in pounds per square inch in the column, we multiply the height in feet by 0.434 and it will be seen that the pressure at which the brine enters the tank is from thirty-five to forty-five pounds per square inch.

It is well understood that before any

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*From a paper read at the Mountain States Ice Manufacturers' Convention.

pump can reverse its stroke it must come to a full stop for an instant. The brine is entering the pump suction under the pressure acquired in the above described manner, and, while the machine is moving, all is well, but at the instant of "stop," in the machine, the brine does not stop. It continues to rush into the pump with force enough to raise the suction valves, which are already on their seats, and allows them to fall back thereon with a loud pound as soon as the machine moves again. It has been the writer's experience that nine times out of ten this is what causes the pound in the brine pumps and not the lack of air in the air chamber.

You might say: "My brine pumps lift the brine by suction as the tank is six feet below the pumps." This would not help the situation any with a closed tank or cooler as the brine would still retain enough pressure to act as above, even though it had to pass through the tank and rise to the pump, as not only will the brine seek its own level but it will be helped out by the vacuum created in the suction pipe by the pump.

The remedy is to install very heavy suction valve springs and, if at all possible, an air chamber in the suction line, using one of the methods shown on the accompanying diagram, giving preference to arrangement No. 1. The benefits derived from a suction air chamber on a brine pump are too numerous to mention here. When the pump starts up there will be a cushion of air established in this chamber and at the moment of each reversal of the machine the brine striking the resistance of the closed suction valves, will rise against the air cushion in the suction air chamber and as the machine moves will flow into the cylinder and follow the piston.

If your brine pumps pound and you make the changes suggested above, it is very safe to say that your troubles in that direction will be at an end.—Illustration and data courtesy of Ice and Refrigeration.

* * *

ANSWERS TO READERS' QUERIES

By R. O. Wynne-Roberts.*

SUBSCRIBER in the February issue of The Power House, page 62, asks why well water that has been subjected to heat freezes quicker than that which has not been heated; and why does water that has been heated take more heat to bring it to the temperature recorded at the former heating?

The above interesting questions cannot be answered in a few words, but the following observations may help to explain the phenomena. It will be necessary to use the terms "hot water" and "cold water" so as to avoid involved phrases; of course, by "hot water" and "cold water" it is meant to convey the fact that the first has been boiled and the second has not. It is palpable that hot water must become cold before it will freeze.

Common Water Contents

All waters as they come from springs, rivers and lakes contain various gases and salts. Rain water contains the least and certain spring waters have the most of these gases and salts. When water is boiled, the dissolved air and gases are driven out, with the result that some of the salts become insoluble and are deposited in the boilers, kettles, pipes, etc., in the form of lime.

The most important gas is carbon dioxide, which mixed with water converts it into carbonic acid. It is, of course, very dilute and, therefore, harmless. This gas is the same as that contained in mineral water such as in lemonade. The more carbon dioxide contained in water the more lime can be held in solution, causing the water to be "hard." Carbon dioxide is easily driven out by heat, and as the lime then loses its support, it deposits in fine powder and cakes in the boilers, etc.

The freezing point of water is at 32° Fah., but if it contain acid or salt, then the freezing point is lower. I have no data at present to show to what extent carbon dioxide and lime salts act in this way, but in the case of sea water which contains salt of another kind, the freezing point is more than three degrees lower than that of fresh water. Consequently in hot water as the gases and salts have been removed from solution, its freezing point must be higher than that of cold water—if from the same source, hot water then will freeze at 32° Fah., and cold water at a lower temperature, provided the local conditions are alike. Freezing takes place suddenly, as a small fraction of a degree is enough to change water into ice. The temperature of the air round the pipes is often just sufficient to freeze the hot water, but not low enough to freeze the cold water. In any case the hot water freezes first.

There are, however, some other conditions which exert an influence.

Still Water Feature

Still water may not freeze at several degrees below its freezing point. There may be instances when quiet water has a temperature of ten degrees less than that needed for congelation, yet any change or movement, or the intrusion of a particle of deposit or ice will cause the water to instantly freeze. Cold water, ordinarily, is not in circulation in a building, but hot water must circulate or something will occur; cold water is quite stagnant until the faucet is opened. Hot water is continuously in circulation even until it starts to freeze, excepting in branches where the hot water is stagnant. There is not much sediment in the cold water pipes, but there is some in hot water systems, and, therefore, it will be seen that the conditions are favorable for an earlier freezing in the case of the hot water than in that of the cold water.

Concentration of Salts by Boiling

Another condition is that the boiling of water tends to concentrate the salts and in time the boilers have to be blown out because the salts have become too concentrated. Such water will have a much lower freezing point, for example, if sea water is boiled until the salts are concentrated, the freezing point is lowered considerably. It would be interesting to have statistics as to the frequency of the freezing of hot water heating pipes, hot water supply pipes, and cold water pipes. Concentration of salts cannot take place in a hot water supply system, but it is possible in the case of hot water heating plant.

It is well known that ice cream is prepared by packing ice and salt outside the vessel. The addition of salt to ice causes the ice to melt and the temperature of the water to drop 20° to 30° Fah., thus confirming the statement that salts in solution change the freezing point of water.

If ice be put under pressure it will melt, consequently water put under great pressure has its freezing point lowered, but this does not affect hot and cold water pipes because the pressure in them is not great enough. Acids and salts not only cause the water to freeze at a lower temperature, they also cause the water to boil at a different temperature. The writer hopes the foregoing will be found interesting and clear.

While the bulk of the explanation has dealt more specifically with the freezing feature, it will be quite apparent that the influences at work in that direction must necessarily be correspondingly operative when raising water to a higher temperature.—Ed.

* * *

I AM figuring on sinking a well in connection with our hotel power plant and would like to have the following questions answered concerning the installation of an air-lift pumping equipment. Assuming a static head of 400 ft.; depth to surface of water, 300 ft.; size of casing, 8 in.; and a pump capable of delivering 100 gallons per minute, what sizes of discharge and air lines, and what submergence—working and otherwise— would be required; also what will be the working load, and how is the percentage of submergence figured?—G. I.

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*Consulting Sanitary Engineer, Toronto.

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EFFICIENCY IN THE POWER PLANT

A WELL-known authority on efficiency has stated that "no one acquainted with the scandalous inefficiency of the average factory power plant, consuming from 5 to 7 pounds of coal per horsepower per hour will question the ability to lower costs 28 per cent., and no one acquainted with the leaks of air, steam and water, leaks of light and heat, frictional losses due to lack of shafting alignment, too light bolts, etc., will question the possibility of reducing the power consumption 30 to 33 per cent." The day is not yet in sight, however, when in every power plant where an engineer is employed, high standards of efficiency can be set absolutely. It is becoming, nevertheless, increasingly important for those engaged in the supervision of our factories, for mechanics and power plant operators generally, to give to the question of efficiency more and more attention, because, in the near future, those only will fill the best positions who are able to at least maintain some definitely established minimum standard.

"SAFETY FIRST" CO-OPERATION

THE movement towards conservation of human life, whether from the snuffing-out or health-maintenance point of view is developing and progressing rapidly—aside of course from the war sphere, although even there, conservation of life schemes and strategies are being actively practised. We are realizing a new outlook in life and are being made conscious of our individual importance. It is true then we can each be done without when the "call" comes, but it is equally true that until then we have a place to fill, and that it is up to each of us to fill it, not carelessly or indifferently, but alertly and diligently.

In view of the latter circumstance, no one conversant with the routine of factories, workshops and power plants will find serious fault with the generally expressed opinion that each operator can contribute more effectively to the furtherance of a "safety first" propaganda than can material safeguards installed in connection with machinery equipment, however efficient these may be. The sense of self-preservation is usually allowed to be a strong, inherent feature of every man's make-up, yet, strange it is that indifference, and a familiarity with environment and occupation tend to dull and blunt its altogether adoption in practice.

The installation of machinery safeguards by an employer should not be looked upon by the employee as making personal care unnecessary. Safeguarding equipment has a limit both as to the extent to which it can be done, in any case, and as to its fitness to meet unforeseen contingencies. Individually and collectively, employees have a responsibility in this matter of "safety first" that nobody else can shoulder for them, and as the responsibility does not entail any irksome obligation, but rather the reverse, we look to see continued and increased co-operative and supplementary effort develop.

INTER-EMPIRE TRADE

AS a result of her development as a manufacturing country, Canada, at the present moment, is probably the most highly favored of all the British Colonies with respect to future participation in inter-Empire trade. South Africa and Australia are so isolated geographically that their progress in manufacturing has heretofore been limited. In addition, the smallness of their home markets, the high cost of factory equipment, and the comparative scarcity of raw materials and fuel, have militated against their industrial upbuilding. There has, however, always been available to our manufacturers, all the materials and conditions necessary to the development of a manufacturing industry on permanent healthy lines.

Manufacturers throughout Canada are alive to the importance and desirability of securing a share of the Empire's requirements in manufactured products, commensurate with our now proven ability to produce. The present stages of development attained by the two colonies mentioned, closely parallel the state of Canadian development some years ago, when agricultural and allied interests overshadowed all other activity. There, as well as here, however, the war has stimulated home production in many lines to a degree which must not be overlooked by our people in the near future.

The President of the Johannesburg Chamber of Commerce, Ernest Chappell, recently said: "Generally speaking, the condition of affairs at present prevailing...... provides a strong stimulus to all South African manufacturers already established, and is giving them an impetus which cannot fail to be of the greatest service to them when they will again have to face competition from outside sources. It may fairly be stated that in this respect the war has constituted the finest assistance for our local manufacturers that they could possibly have had."

Such a statement from such an authority should receive careful attention by prospective exporters, not as a deterrent, but rather as an indication of future opportunities. For many years to come Canadian conditions will favor the production here of many articles, affording our manufacturers the opportunity of building their reputation on solid foundations. What these foundations consist of must be clearly recognized by us, even as they are beginning to be recognized by competitors abroad—"Uniformity of quality and regularity of production are conditions absolutely essential and fundamental to success in any manufacture"—and in no case we might add is the necessity more vital than in export work.

The Operators' Point of View

ROPE STRAIN PROBLEM

By N. G. Near.

WITH reference to the query of J. R. H. under the above title in a recent issue, we all have doubtless known for a great many years that there is no difference in tension between Figs. 1 and 2, appearing there. This is true because of the old law of physics—"Action and reaction are equal and opposite in direction." Yet, that isn't a good answer. Just because a law says a certain thing it doesn't necessarily prove that the thing is right, for even laws may sometimes be wrong. It is stated, for example, that the well-known laws of gravitation aren't "absolutely accurate," but are very close—close enough for all practical purposes. Perhaps, as far as I know, they are "absolutely accurate." I am merely quoting others who have studied laws of gravitation more than I have and should therefore know more about them. In consequence, we will assume for the present that the old "action and reaction law is wrong," and go after the "proof" which J. R. H. desires.

I rigged up a little device as shown in the sketch and instead of a rope used a string around the pulley. I applied load enough with my hands to break the string. I used five different lengths of string, all from the same ball, and noted the places where the string broke each time. In no test did the string break at the "middle" of the contact with the pulley. It broke in the places I have indicated by number, the numbers designating the number of the tests made.

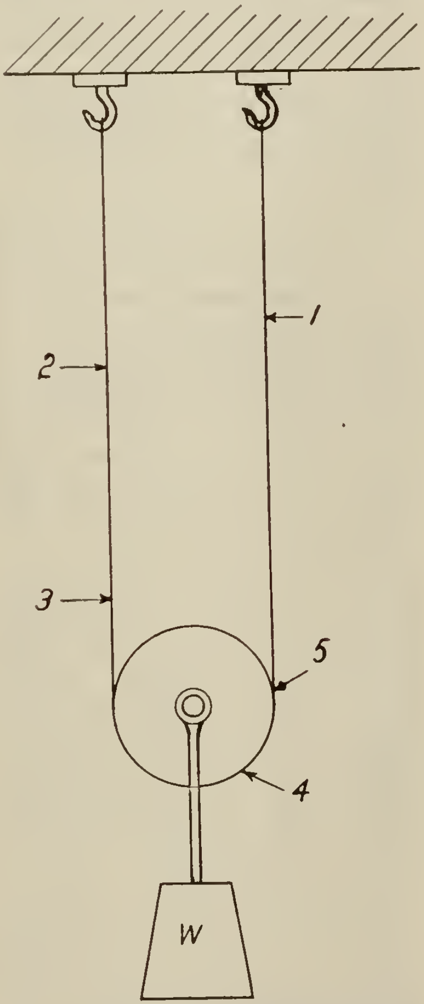
Since a string is fairly uniform in strength from end to end, and since my results are fairly uniform, I consider this pretty good "proof" that the tension is equal all over the rope or string, as the case may be, and that therefore no difference in tensions exist in the two figures accompanying the original query. The old "Action and Reaction Law" is also vindicated.

LUBRICATING OIL FOR AIR COMPRESSOR CYLINDERS

By A. J.

IN an article by J. M., in your February issue, I note a reference to the lubricating oil for air compressor cylinders as special oil, and, further on, "the oil salesman usually patronized can probably furnish a supply of good air cylinder oil without difficulty."

It was always my impression that it was the engineer's province to be acquainted with the nature of the various oils used and be able to inform the oil salesman as to the special service of the oil he requires. Further on, he states, "even with the best of lubricating oil, it is good practice to use a little coal oil or soapy water on the valves at times to prevent gumming."



ROPE STRAIN PROBLEM. DIAGRAMMATIC PROOF OF SOLUTION.

If I found any engineer using coal oil in an air compressor, I should not give him time to even get his coat, but would run him off the job so quick that he would lose his breath, that is of course presuming that the air compressor did not save the effort.

There is nothing more dangerous when put into an air compressor than coal oil, except perhaps gasoline, and one of the most important requirements of cylinder oil is that it should have a high flash point to prevent all liability of explosions through the formation of gas. This is recognized fully by the makers of refrigerating machinery, very strict injunctions being given their erecting engineers to be exceedingly carful while putting on the air test as to the oil used in the compressors.

SHALL I BUY OR MAKE MY POWER?

By W. B.

THIS is an easy question to ask oneself, but not so easy to answer. We must first work ourselves into a state of profound analysisitis and gain a clear understanding of first cost and the "ifs and ands" connected therewith. Perhaps it is first cost and then again, it isn't first cost at all.

Generally we are of the belief that the money we immediately "shell out" is first cost, but with a mortgage on the place, a small prepayment, and a promise to pay, it can sometimes be shown that there is no first cost at all. It is just added to the depreciation, subtracted from the sinking fund, divided by a safety factor and multiplied by two.

In the long run, after sifting the ashes, picking out the good coal, and playing a game of dice with them, we can decide the problem with the most sensible of logic.

CONCERNING PREMONITIONS

By Woodworker

"I THOUGHT it would break, and it did." The above "wise saying" is heard much too often. It should not be heard at all, for whenever it is feared that something is going to snap, it should be thoroughly investigated, so that one's mind may again be at ease. If the design or construction is wrong, it should be made right. If your investigation proves that everything is

O.K., very well, your premonition will vanish.

For some reason or other, an engineer friend of mine worried constantly about the belt that drove his exciter. He feared it would break any minute because it often slipped off the pulley on starting. He looked it over carefully every day. He kept the lacing in tip-top shape. He did everything, almost, except to investigate the matter. The belt was three times stronger than necessary and was amply safe. The exciter pulley was simply too small and the trouble was easily remedied. After the belt stopped slipping off, my friend had no more premonitions. However, had it broken before the investigation he doubtless would have said, "I thought it would break, and it did."

I can think of no case where a man who is entrusted to care for a plant could utter these words in a careless care-free manner, especially if the break is of a serious nature.

LICENSE LAWS FOR STATIONARY ENGINEERS

By M. A. C.

I WAS not amused by the article in the December issue of The Power House, by R. McLaren, as I have not had the advantage of traveling around the world several times like your correspondent—January Power House, page 17—who states that he has done so. However, so far as my limited experience goes, I can state that some of it has been along similar lines to that of Mr. McLaren.

Backward Canada, especially Ontario, so dubbed in somewhat different words by C. T. R., is the only country under British rule where the engineer is recognized as a (stationary) engineer without being a qualified mechanic. I wish to dispute this assertion. The Canadian stationary engineer is a qualified mechanic and of a very high order at that in most cases. This does not mean that he is a journeyman machinist, or has had machine shop experience.

Personally, I have had 15 years' experience in plumbing, steamfitting and shop practice, two years having been spent with the Canadian General Electric Co. I have helped to install considerable power equipment ashore and afloat and have been over 10 years in power plants as chief engineer. I know many stationary engineers in Canada who have had no shop experience, and who, I am willing to confess, are a whole lot better than myself as power plant chiefs. Although I am not a graduate of the S.P.S., I have to my credit diplomas from some high grade correspondence schools in engineering. I may be what is known as a "thick head," but I do not think so.

As a rule, the British Navy engineers and helpers are "top hole," but even there exceptions can be found, and perhaps Mr. McLaren bumped up against some of these exceptions. My experience with one of them four years ago is as follows:

A man applied for a position on the engineering staff. He had honorable discharge papers from the British service, showing that he had served seven years in the engineer's department, giving satisfactory service, and that he had been discharged on account of defective sight and ill health (if I remember rightly). His technical knowledge was next to nothing, his practical machinist experience must have been mighty small, but his capacity for beer was great. It would almost make one sleepy to watch him work. His capabilities would be reckoned on a par with a third-rate Canadian engineer as I know them. The Lord forbid that there are many men like him on Britain's ships. However, it goes to show that there are poor British engineers as well as poor Canadian ones. A lazy, careless man will never make a reliable or qualified engineer.

Unlike C. T. R., I have not traveled the salt water ,but I have covered considerable U.S. ground, and I can say with certainty that Canadian engineers can easily compete and come out even with the American product. Like C. T. R., I am also Canadian born, although both my parents were born in "Auld Reekie" in Scotland. My father was an engineer but he confessed that when he came to Canada he learned a lot about steam engineering which he had never heard about in the Old Land.

The British Board of Trade examiners are not infallible any more than any other board and it is quite within the bounds of possibility that a poor prospect may slip through now and again. It is also possible for a man to travel around the world every once and awhile, and unless he was doing practical power plant work he would learn little about the end of the game in question. I agree with C. T. R. that the license law in force here is "punk," but "knock the Government" for this, not the engineer. If he is in the game deep, he will know that most of the engineers here are eager for a stiffer examination along real, practical, safety first, power plant operation.

ENGINEERING HUMILITY

By W. F. S.

ARE you a better man than the other fellow whose position you would like to hold? When you are wrong, are you willing to admit that you are wrong, or, do you attempt to "crawl" out of the awkward position into which you got yourself by ceaseless wrangling? Are you a good loser? In case you should be fired to-morrow what would you do or say? Would you have a "fight" with the boss and make your position worse, or would you talk it over with him in a sensible way, meet the inevitable calmly, blaming yourself as much as possible, and blaming the boss as little as possible?

I know an engineer who was told to leave because his services "weren't satisfactory." The boss couldn't give him any definite information as to exactly what was wrong, and so the engineer decided that he was up against "politics." Instead of taking off his coat and offering to fight everybody in sight, this man thought it over carefully, was calm throughout his thinking and talking and finally decided to stay even at a reduction in salary.

The boss wasn't prepared for such humility, and as he didn't really have good grounds for firing the engineer, the outcome was that the latter remained at the same salary which was shortly after increased. The boss has more respect for the engineer now, talks everything over with him, and sort of pals with him, just as bosses should do.

This is no "sure cure" for all troubles. It only illustrates one of the many ways in which troubles can be remedied. Very often men cannot be blamed for "flying off the handle." As a general rule, though, dignified humility and politeness are best.

We all dislike men who "suck around" for a soft snap, as the expression goes; we also dislike bullies. There is a happy medium that we can attain only by careful study of the boss's character and by constantly subjecting ourselves to sober-minded thought.

LICENSE LAWS FOR ENGINEERS

By "Novice"

I HAVE noted with great interest the discussion going on for some time regarding license laws for stationary engineers in the different provinces.

While we are pretty much in agreement that the Dominion Government should take this matter in hand; we are not apparently in agreement as to the qualification and training necessary for the engineer to have. Some want the entry to the engineering profession to be by way of the shovel; others make it a sine qua non for shop experience; and others a combination of both; but in no case is there a word for the student in the engineering classes.

Why not have a certain amount of theoretical experience included with the practical? Surely if education is necessary in these modern times, a man with theory as well as practice is the man we need. This of itself grades the man, although all are necessary to the working of the plants in this Dominion or elsewhere.

The only necessity is to grade the plants in conformity with the training of the men and make provision for the fit men from one grade to pass into another. Mr. McLaren appears to have had an unfortunate experience with B. O. T. engineers. There is, however, this to be said in their favor, their whole training is for the practice of engineering from the moment they enter the shop until they succeed in reaching the goal they are aiming for.

There are some shops that keep that end in view and bring their apprentices through the various stages, from a screwing machine (where they will learn the sizes of bolts, pitch of threads and angle of pitch), to lathe, shaper, slotter, miller, planer, drill and vise work, allowing them also to spend some time in the plumbing, coppersmith, brass working, patternmaking, boiler, and blacksmith shops; and from there to the drawing office. In addition attendance at evening technical classes are made compulsory so that while obtaining the practical they also obtain the theoretical. There is thus acquired a valuable training to fit them to take charge of plants and operate same to the best advantage. This type of engineer is not a specialist nor perhaps an expert in any of these branches.

There are others, however, who leave the boy to his own devices, and use him to swell their profits, caring nothing as to what becomes of him after his five years are completed. In this case he may become expert in one branch only. In the first case, seven years are none too much to turn out a valuable man: while in the second case, five years is too long for the type which will emerge, unless there is a decided mechanical bent coupled with the wise direction of the parents and propagation of observation and imitation.

Mr. Laren may have come across some of those who have managed to pass the B. O. T. examination after an experience in a shop of the last mentioned description, and who have gravitated to Canada because there has been no place for them in England. I will quote a portion of an article which I believe was written for an Edmonton paper three or four years ago as follows:

"In every case that I know of, the engineers who run these jobs are marine engineers with chief engineers' certificates, which means that they have served at least seven years in a shipbuilding and marine engine shop and have done at least four years at sea, where they have to make sure that their overhauls are properly carried out and where they have to be able to carry out all their minor repairs at once. A friend of my own at Cardiff was eight years at sea as chief engineer of a five thousand horse-power steamer before he passed to the Cardiff power plant as junior, but he was qualified by experience as well as on paper.

"Others are now engineers in big commercial or civic employments drawing good salaries but earning them by the exercise of knowledge gained in years of actual experience and not in correspondence or short-term universities."

This quotation could be added to ad. lib. Who hold the positions of boiler inspectors to the Hartford Boiler Insurance Co., both in the United States and Canada? to say nothing of the draftsmen, superintendent, engineers, and the engineers of the largest hotels and power plants in Great Britain, India, China, Africa, and Australia, as well as of the Brazils and Argentine.

The real fact of the matter is that the B. O. T. man is out of his element in the small power plant and his hands are tied too much to demonstrate his capability. Too much of the rough work is handed to him to which he will only give half-hearted attention having already passed through that stage. Further than that, however, his suggestions are not carried out, time is not given to lay off machines or boilers for the necessary repairs or alterations to be made, coal consumption is not taken into consideration, or for that matter anything else, the one consideration being to keep the plant going at all costs.

C.A.S.E. CONVENTION

The Annual Convention of the Canadian Association of Stationary Engineers will be held in Montreal, P.Q., on July 25, 26, 27.

To take the lake steamers, the coal consumption is from fifty to one hundred per cent. more than an English ocean-going steamer of equal size, speed and horse-power; and you will be told it does not matter about the coal, so long as you keep the boat going.

The proper course seems to me to cooperate with the shops, train up a class of men passing through these stages, and fit them for the first-class plants and raise the standard of engineers in keeping with it.

This would of course mean grading of certificates, for it is obvious a small plant could not in reason be expected to engage the services of a man of this type, nor would it pay to do so. The difficulty arises in devising some means by which the untrained man who fits himself for the higher grade by hand work and study can pass from the lower to the higher, and so framing laws under Dominion control that would allow him to do so. This, I think could only be met by taking each individual case on its own merits and not by any hard and fast regulations.

These regulations would need to be enforced in all fairness. It is no use having stringent regulations if they are not carried out. Alberta is given the first place in stringent regulations and graded certificates, and what is the result?

The grading is valueless for the following reason: It is left to the inspector's discretion as to the definition of a first-class plant, and while the Act calls for all power plants over 500 h.p. to have a first-class man in charge, yet if a plant of more than 500 h.p. does not operate more than that limit at one time it is permissible for a second-class man to have charge.

This is far-reaching in practice, for, if carried out to its logical conclusion, it is possible to have 2,000 or more h.p in a plant and by blanking off every 500 h.p. and putting a second-class man in charge of each section you would never require a first-class man in full charge.

The operation is thus subservient to the charge of the plant, and is wholly inadmissible for the reason that having charge of a plant carries with it the power to operate if desirable and necessary, and who is to say when more boilers are required and are put in service unknown to the inspectors? Certainly not the men who would be displaced by a first-class man in that event.

Another loop-hole is given under the regulations for heating plants. Here it is possible for a fireman to have charge of unlimited horse-power of 100 lbs steam pressure when it is used for heating purposes only, yet a second-class man is limited to 500 h.p., with a great deal more experience and education.

The claim is made that the care, maintainence and safety of the boilers is the primary object in boiler regulation Acts —surely a curious anomaly. It appears on the face of it that the only object in having these Acts is for purpose of revenue, and it would only be reasonable to agitate that the whole question of licensing engineers for stationary plants be done away with and each employer be allowed to select the man who he thinks best fitted and adapted to operate his plant as is the practice in Great Britain, holding the owner of the boiler responsible for any damage or loss of life occasioned by engaging incompetent men to operate them.

SHOULDN'T THE ASSISTANT KNOW ALL?

By S. W. B.

VERY seldom do we hear a chief engineer say, "My assistants know just as much about this plant as I do." Why don't they say that? Well, in the first place it is quite possible that 90 per cent. of the chiefs wouldn't be telling the truth, and the others would think it unwise to admit it if it were the truth. It is pretty hard for a chief to humble himself before his help.

Chief engineers are good, bad, and indifferent. We have all kinds of them, yet it has been my experience that we can generally divide them into two grand divisions. First—Men naturally endowed with a sense of divining the fitness of things in the order of their occurrence. Second—Men who, because of their superior position on the pay-roll and by virtue of their titles take great delight in handing advice and remarks to their understudies that they themselves would put on the shelf or ignore as being unnecessary, if personally received from a higher official.

The first class seem to possess the same uniform degree of judgment whether in the act of executing the work personally or superintending it. They have the excellent property of always correctly distinguishing between the right and the wrong way of doing a thing. They have confidence enough in a man who has specialized along a certain line to believe that such a man will, in all ordinary work pertaining to that line, follow the proper tactics in its execution.

The second class are a self-conscious lot. They reason within themselves that, being placed in command of several men, they know more than all subordinates put together. If they feel that they are lacking in knowledge, they proceed to build foundations for themselves when an inspector, manager, or owner is near by "bellowing" at the workers unfortunate enough to be then under observation. I was once under such a man who repeatedly shouted, "Be sure and get that joint steam tight;" "Give that valve another turn;" "If you'd turn that nut the other way it would probably go on;" "Did you put a gasket in there?" "Are you sure the pressure side of that valve is next to the main?" And so forth.

Of course we would submit to his insults though secretly we wished we had nerve enough to stand up and talk to him. Later, when the chief was well away, we would join in a chorus of brainstorms and tell each other what we thought of him.

Such chiefs are also "finnicky" at times. In working with an S-wrench one day bolting up a header I knocked the bolt into the hole with the wrench because it was handier than to get a hammer. Besides, it was light work anyway. The chief saw me do that unpardonable thing and he "lectured" me. "A wrench isn't a hammer," he said. "You should know that by this time." I noted that he was "showing off" to the manager, and so I swallowed it without a murmur.

Another time the chief overheard me ask of a fellow worker, "Where's the big pipe wrench?" He answered, "I don't know." "Sit down, gentlemen," chimed in the boss ironically, "I'll get it for you."

Fortunately, men of this type are rapidly disappearing. The "first division men" are taking their places, and work is being done more smoothly, peacefully, intelligently. The assistant is instructed, not nagged, and that is why, in many of our modern power plants, the chiefs can and do truthfully say, "My assistants know just as much about this plant as I do."

READERS' QUERIES

SOMETHING happened a few days ago that to me seems hard to understand. A brass pop valve on the inlet to an air compressor tank melted off. This strange occurrence took place in my presence, and I am desirous of knowing the cause, also if it is likely to happen again with this particular compressor equipment, or is possible with others. The compressor is a single cylinder, motor-driven machine. The valves are of steel, and are kept to their seats by springs. An automatic regulating device maintains the air pressure at 70 pounds per sq. inch, the air intake pipe being throttled when excess pressure becomes imminent. The tank or receiver is connected to the compressor discharge by a pipe something under 6 feet long. There are no valves on this pipe. A pop safety valve on the tank end of the latter, pressure gauge and blow-off valve, all in good order and frequently tested, constitute the air tank equipment. The compressor stroke is about 18 inches, and, although rated for a lower speed and pressure, present requirements called for an overload and a turning speed of some 300 r.p.m.

Several of us have ideas concerning the melted pop valve, but no expert being available, we, together with the man in charge of the operation of the outfit, are merely guessing. The operator's idea was that dirt had got under the delivery valve and the air going through on one stroke and leaking back on the next or return stroke had caused the valve to heat and set alight the poor grade of oil used. Others thought that the friction of the hot air going through the pop safety valve caused the latter to heat and the oil in suspension helped the end along. The compressor cylinder is well water-jacket and plenty of water was circulating.

I shall be glad to have expressions of opinion from readers of The Power House regarding the pranks of this air compressor installation.—C. K. F.

COST OF LIVE FLOWING STEAM

By W. F. S.

TOO few engineers appreciate the value and usefulness of Napier's formula. It is used, generally, wherever steam is allowed to flow directly from high boiler pressure into the atmosphere, as in furnaces for creating draft, in soot blowers, in whistles, etc. The formula is

$W = \frac{p\,a}{70}$, where

w = the weight of steam in pounds flowing through the area (a) per second.

p = steam pressure in lb. per sq. in.

a = area of orifice in sq. inches.

To make this formula a little more applicable to most engineering conditions, I have converted it into this form:

Cost of steam in dollars per 10-hour day $= \frac{9\,p\,a\,c}{35\,s}$, where the additional letters represent the following:—

c = cost of coal in dollars per ton of 2,000 pounds.

s = pounds of water evaporated into steam in the boiler or boilers per pound of coal.

For example, what is the cost of the steam per day flowing through a ½ inch nozzle for creating draft in a furnace where,

p = 140 pounds per sq. in.

$a = (\frac{1}{2})^2 \frac{P}{4} = 196$ sq. in.

c = $4 per ton.

s = 8.5.

Substituting in the formula, we get,

$$\frac{9 \times 140 \times .196 \times 4.}{35 \times 8.5} = \$3.32 \text{ per 10-hour day.}$$

ANSWERS TO READERS' QUERIES

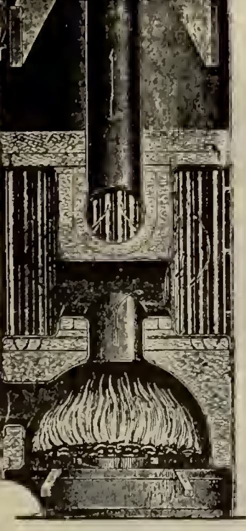
WITH regard to belt trouble query by "Cottam" in the February issue of The Power House, I would suggest remedies as follows: First, that he increase the diameter of pulley on grinder to at least 8 inches, as at present it is running over 200 r.p.m. faster than it should, the increased speed causing slippage to an abnormal extent. Second, I would use a single leather belt, or two single belts over the same pulley. The drive is too hard for a rubber belt as the heat generated on the small pulley spoils the belt by causing the vulcanizing or gum to collect on the two outer edges, the belt sticking in consequence, and being followed by slippage first on one side and then on the other. I think, however, the increased size of pulley will be sufficient to meet the situation and this may be easily, quickly and cheaply accomplished by fastening a piece of old belting about ¼ inch thick around the present pulley.—L.D.M.

Operators' Instruction Course

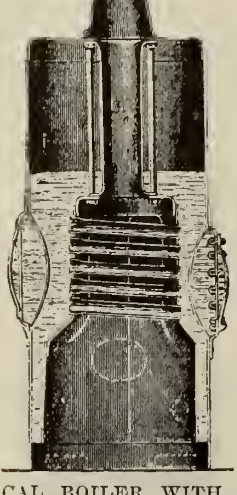
THE STEAM BOILER—III.

IN a previous issue, under the subsection heading of Boiler Classification, we noted that steam boilers were not only subject to two main divisions—those internally fired and those externally fired, but became still further divisible into what are known as smoketube and water-tube types. Nevertheless, all boiler designs however distinctive they be in constructional detail and general appearance embody one or other of each of the primary or secondary subdivision features.

Essential constituents of every steam boiler are the furnace with its firegrate on which is laid the fuel, and the water-containing vessel, however, simple or compounded which absorbs heat from the combustion of the fuel and causes steam to be generated. Quantity and quality of fuel burned on the firegrate determine the quantity of steam that will be generated, and, in the same connection, the quantity of fuel consumed will be dependent on the firegrate area and furnace draft. The length of firebars should be reckoned as a factor in fuel consumption, as with a short grate the consumption is larger comparatively.


VERTICAL BOILER WITH SMALL VERTICAL WATER TUBES.

When we speak of the efficiency of the furnace there is implied the capability of the latter to consume with the minimum of loss or waste the whole of the fuel that may be placed on its contained firegrate and that of course without an unnecessary or superfluous air supply. To produce perfect combustion there must be as little waste of heat as possible in obtaining the necessary draft. The portion of heat generated which is utilized in the production of steam is known as the available heat. It is common knowledge that a given firegrate may consume a considerable quantity of fuel without thoroughly burning it, and, therefore, without releasing all of the contained heat units. Again, with the fuel completely burned, there is usually but a comparatively small portion of its heat obtainable for the definite purpose intended.

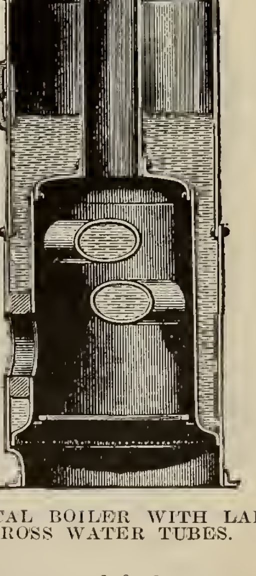

VERTICAL BOILER WITH SMALL INCLINED WATER TUBES.

Sources of Heat Loss

The chief loss of heat from the fuel consumed may be reckoned as due to the stack, the latter being according to a competent authority nothing more or less than a rough-and-ready way of inducing air to flow into the furnace and through the fuel bed with sufficient velocity to cause the fuel to burn. Heat losses may, however, take place in the furnace itself, and the cause of these may and does result from poor or careless stoking, lack of air supply, excess of air supply, and radiation, the latter especially when fire doors are open for an unnecessarily long time, when stoking.

All of the foregoing losses can be minimized if not wholly eliminated, although the degree attainable by each may in a given case be quite disproportionate. With bad stoking the best designed and constructed boiler may prove very inefficient. A phase of bad stoking is that in which fuel is lost by falling through the firebars into the ash pit, either green or only partly consumed, and is drawn off with the ashes for disposal as such. Good fuel on account of its friability tends to this unless the fire-bar arrangement is installed to offset it. Carelessly laid fire-bars will, however, always be liable to allow partly consumed or green fuel in lesser or greater quantity to pass to the ash pit.

Stoking as we have seen contributes to a loss of heat in two directions, and one of these—the loss through partly consumed fuel belongs also to the circumstance of lack of air supply. In this case, the partly consumed fuel passes through the tubes to the stack as carbonic oxide, being discernible as soot deposited in the tubes, etc., and as smoke. Bad design of


VERTICAL BOILER WITH LARGE CROSS WATER TUBES.

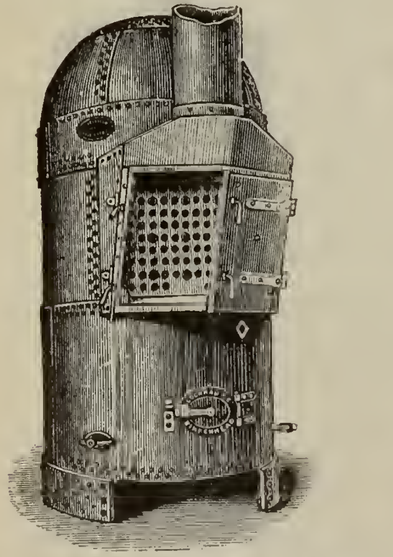
furnace and accessory parts, particularly in the provision of means for air supply regulation contribute their quota to this phase of furnace inefficiency, but here again the stoking is often blameworthy, because of carelessness or lack of intelligence on the part of the fireman to take full advantage of such aids as may be available to him.

Inefficiency of the furnace through excess of air arises from a certain amount of the heat generated being employed to heat this excess air. Such heat is of course lost, being valueless for steam raising. Bad stoking here again is responsible, fire-bars being more or less bare in parts, thereby allowing a too large volume of air to pass between them.

As regards radiation losses due to an over-extended fire-door opening period when stoking, while some heat must necessarily disappear in the wrong direction, its relative percentage value in terms of the total due to the combustion of the fuel, should we might say, be low and is wholly up to the fireman to keep at a minimum.

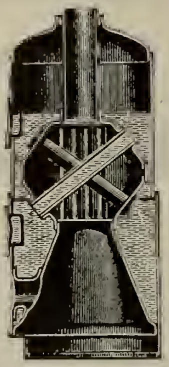
Evaporation Per Pound of Fuel

The value of a fuel is determined by its chemical composition. All fuels contain more or less carbon; most of them also have hydrogen and oxygen in varied proportions, while some again have small quantities of nitrogen, sulphur, etc. Most coals have not a greater evaporative power per pound than 14½ pounds of water from and at 212 degs. F., if burnt to carbonic acid and steam. Allowing 7 per cent. for ash and waste in clinker and cinder we get 13½ pounds of water as the maximum theoretical quantity which could generally speaking be evaporated per pound of fuel. Assuming the quite high boiler efficiency of 70 per cent., we get some 9½ pounds of water evaporated as a result. In practice, 8½ and 8¾ pounds may be reckoned as regularly attainable.

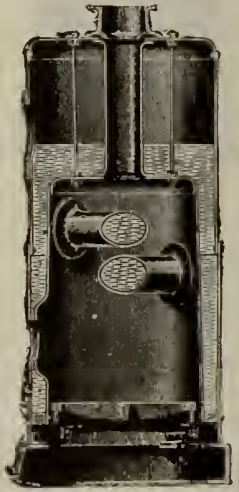


VERTICAL BOILER WITH HORIZONTAL SMOKE TUBES

A pound of carbon is capable of creating during its complete combustion a certain quantity of heat. This is termed the total heat of combustion and is reckoned as so many units of heat. The heat unit, or British thermal unit (B.t.u.) as noted in Article I., of this series is the quantity of heat required to raise the temperature of one pound of pure water one degree F., with the latter at or near its temperature of greatest density—39.1 degs. F. When hydrogen is present in a fuel, its total heat of combustion is measured in like manner to carbon, and, when compounded with the latter, the total heat of combustion of the combination is representative of the sum of the quantities of heat contained in and produced by each, were they burnt separately.



VERTICAL BOILER WITH DIAGONAL WATER TUBES.



VERTICAL BOILER WITH LARGE CROSS WATER TUBES.

When oxygen as well as hydrogen is present in a fuel, we have an element combination which goes to form water; in other words eight parts by weight of oxygen will take to one part by weight of hydrogen and form water which has no heat value or does not add to the total heat of combustion. If, however, there be an excess of hydrogen present in the fuel beyond that necessary to form water with the oxygen, then this excess may be reckoned as contributing to the total heat of combustion.

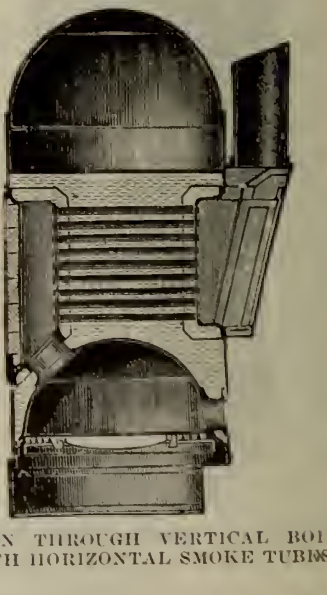
To consume hydrogen gas requires 8 pounds of oxygen or 36 pounds of air. It can evaporate 64 pounds of water from and at 212 degs. F., its total heat of combustion being 62,000 heat units. Carbon on the other hand, when fully burnt requires but 2.7 pounds of oxygen or 12 pounds of air to consume it, or, in other words, convert it into carbonic acid. Its total heat of combustion is 14,500 heat units and its evaporative capacity is 15 pounds of water from and at 212 degs. F. When partially burnt or converted into carbonic oxide, half of the air is consumed and the total heat of combustion becomes 4,400 heat units. In good coal sulphur is present but sparingly; its total heat of combustion is around 4,000 heat units.

❖

Trade Gossip

The George T. Ladd Co., Pittsburgh, Pa., owners of the improvements in the Milne Vertical Water Tube Boiler, covered by letters patent of the Dominion of Canada, Nos. 162, 401, and 162, 402, dated May 4, 1915, have granted licenses to The Goldie-McCulloch Co., Galt, Ont., to manufacture and sell vertical water tube boilers, embodying the improvements claimed in said letters patent.

The Turbine Equipment Co., engineers, Toronto, Ont., have recently secured an order from the Imperial Oil Co., for ten De Laval steam turbine-driven centrifugal pumps to be installed at their new refinery, Montreal; also a contract from the Standard Chemical, Iron & Lumber Co., for a one and a-half million gallon De Laval motor-driven centrifugal pump.



SECTION THROUGH VERTICAL BOILER WITH HORIZONTAL SMOKE TUBES

Question and Answer Series

Question.—Enumerate some considerations which are worth while being taken account of when raising steam and indicate why?

Answer.—See that there is sufficient water in the boiler before the fire is lighted. Do not force the fire when getting up steam, but let it burn slowly, so as to heat the boiler gradually. If the water is cold take not less than about three hours to raise steam in a small boiler and twice as long in a large one. If for special reasons it is necessary to hurry, less time may be allowed, but if steam is raised too quickly, the boiler will be strained and wear out quickly.

* * *

Question. — Without refering to a table, how can I change a decimal measurement to fraction as thirty-seconds, sixty-fourths, etc., and vice versa?

Answer.—To change a decimal to an equivalent fraction whose denominator is known, multiply the decimal by the required denominator and the integral part of the result will be the numerator of the fraction: thus .375 to sixty-fourths =

$$.375 \times 64 = 24.000 \text{ or } \frac{24}{64} = \frac{3}{8}$$

Again to change .0469 to the nearest sixty-fourth

$.0469 \times 64 = 3.0016$ or a shade over 3-64.

To change a fraction to a decimal, divide the numerator by the denominator and proceed to the desired degree of accuracy: Thus, what is the decimal equivalent of 7-64?

$7 \div 64 = .109375.$

* * *

Question.—What steps should be taken to empty a steam boiler, say, for interior inspection and cleaning-out purposes? Is it good practice to employ the "blow-down" method, if time and circumstance are immaterial? If these are important—as they often are, and "blowing-down" has to be resorted to, what precautions should be adopted?

Answer.—Do not draw the fire, but allow it to burn out, and keep the fire-door and damper shut until it has done so. Do not empty the boiler by blowing the water out, but let it cool with the water in: the water can afterwards, if necessary, be run or pumped out. The steam may be very gradually blown off at the safety valves and, if necessary, the man-hole door may afterwards be taken off to expedite cooling off. Do not take the mud-port doors off until the boiler is thoroughly cooled. Do not put cold water into the boiler to cool it, either by running-up or by pumping. If sufficient time cannot be allowed for the fire to burn out and the boiler to be well cooled down before it is emptied, the fire may be drawn and the water blown out. Care should be taken, however, to have the furnace plates, bars and bridges as cool as possible, and the steam pressure lowered to 50 lbs. per sq. in. or less. It is better not to blow out quite all the water, but to leave a little in the boiler bottom, which can be run or pumped out when the cooling is thoroughly effected later.

* * *

Question.—How is the total heating surface of a return tubular boiler set in brickwork reckoned, and what would it amount to in a boiler 66 inches diameter by 15 ft. long, and containing sixty 3½-inch diameter tubes?

Answer.—The lower half of the boiler shell throughout its length and the surface of all the tubes constitute what is known as the total heating surface in this type boiler. The shell heating surface amounts to one-half the shell circumference in feet multiplied by its total length also in feet. Thus, 66 inches shell diameter, which is 5.5 feet, will have for half circumference

$$\frac{5.5 \times 3.1416}{2} = 8.6394 \text{ feet.}$$

8.6394×15 feet length of shell will give 129.59 square feet, or total shell heating surface.

The tube heating surface is the circumference of the external diameter of one tube in feet multiplied by the length of tube also in feet and again multiplied by the total number of tubes.

The circumference of one 3½-inch tube in feet is found thus

$$\frac{3.5 \times 3.1416}{12} = .9163 \text{ feet.}$$

We divide by 12 because the multiplication of the two upper quantities gives result in inches. Total tube heating surface $= .9163 \times 15 \times 60 = 824.67$ sq. ft.

Adding together the shell and tube heating surfaces, we get $129.59 + 824.67 = 954.26$ sq. ft. as the total heating surface of the boiler.

* * *

Question.—Define the principles by which a refrigerating unit accomplishes its purpose, and indicate briefly the cycle of operations involved.

Answer.—We compress by means of external force a gas or vapor and extract its heat to diminish its volume. Again, by causing the compressed gas or vapor to expand, we lower its temperature. Heat is next absorbed by the gas or vapor, and the latter resumes its original condition. Continuity of this cycle of operations maintains the refrigeration effect.

* * *

Question.—We find Corliss valves fitted to steam engines in many power plants. What are their advantages over a slide or piston valve, and what are the disadvantages in comparison?

Answer.—Corliss valves reduce the port clearance to a minimum, give practically a full steam admission opening and sharp clean cut-off instantaneously, permit of water of condensation being drained off through the exhaust ports, are adaptable to close governing, and give independent exhaust valve adjustment. The principal disadvantage lies in the number of revolutions obtainable per minute, these being limited to 150 probably as a maximum, due to the uncertainty of the trip gear engaging and disengaging properly.

* * *

Question.—What are the usual arrangements of Corliss valve gears as found in good stationary steam engineering practice?

Answer—a.—Gears without trip motion, the valves having a positive connection with the eccentric, the valve travel being constant, and the point of cut-off invariable. This arrangement is not much used.

b.—Single eccentric gears with trip motion, the steam valves not being positively connected to the eccentric, but being opened by trips or catches against the resistance of a dashpot and released at some point of the engine stroke, determined by the governor or otherwise.

The exhaust valves are positively connected to the eccentric and receive, therefore, a constant movement .

c.—Double eccentric gears with trip motion, the steam valves being connected and operated in the same manner as those of the single eccentric with trip gear. The exhaust valves are, however, driven from a separate eccentric.

* * *

Question.—Why are the tubes beaded on the rear head of a return tubular boiler, and need they be so on the front head as commonly found in practice?

Answer.—The tubes are beaded on the rear head because their thin edge projecting beyond the plate into the combustion chamber is removed a considerable distance from the water in the boiler, comparatively speaking, and meets the gases from the firegrate before they have transmitted their high temperature heat sufficiently to ensure against the tube ends becoming red hot, burning and loosening the effectiveness of the tube expanding.

They need not be beaded on the front head, because by the time the gases reach there, their temperature is, or should be, reduced on economical grounds, to a point below that of danger of burning. Further, the gases are passing out instead of coming in and impinge less hurtfully on the tube edges. A reason, however, for beading on both front and rear heads is that as no stay tubes are fitted, additional rigidity is secured beyond mere "rolling" or expanding. Stay tubes when fitted are screwed into each head and distributed at lesser or greater intervals of general tube spacing, according to steam pressure carried.

* * *

Question.—Why is the return tubular boiler set in brickwork so much in favor as to be generally installed in factories and industrial plants?

Answer.—Because it is cheap to construct, therefore a low first cost to its owner. It compares favorably with other types in economy, efficiency, and lasting qualities, if properly designed, constructed, operated and cared for.

* * *

Question.—What are understood by the terms exhaust lead and exhaust lap, as applied to steam engines?

Answer.—The terms exhaust lead and lap apply to the slide and piston valves of a steam engine in their middle position on the cylinder valve face, when showing in the former case the ports to cylinder and exhaust pipe open to each other, and in the latter case closed to each other something beyond the "clipping" amount.

* * *

Question.—What is the effect of exhaust lead?

Answer.—Exhaust lead permits of an earlier release or escape of steam and a later compression or closing of steam passage to the exhaust pipe, at the end of the cylinder from which the piston has come and to which it is going in each case respectively .

* * *

Question.—What is the effect of exhaust lap?

Answer.—Exhaust lap permits of a later release or escape of steam and an earlier compression or closing of steam passage to the exhaust pipe, at the end of the cylinder from which the piston has come and to which it is going in each case respectively.

* * *

Question.—How is the surface of a bearing reckoned and why?

Answer.—The surface of a bearing is found by multiplying the diameter in inches by the length in inches. Example—A 3-inch diameter shaft running in a 6-inch length bearing would be reckoned as having 18 square inches bearing surface. The reason for the diameter being used in the calculation instead of the circumference is that the pressure is not exerted all round the bearing, but only top and bottom, front and back, as the case may be, and on either one alone at a given time. The effective surface to take this pressure is one-third of the circumference, and one-third of the circumference is equivalent to the diameter, hence the use of the latter in the calculation.

* * *

Question.—What is understood by the expression "duty" as generally applied to steam engines?

Answer.—By "duty" is meant the fuel economy or work accomplished on a given expenditure of heat. It is a recognized standard of performance, and like the 33,000 foot pounds per minute horse-power standard, originated with and was established by Watt. Three methods of duty rating have been employed; the third, however, is that most generally adopted. They are as follows:

1—The number of pounds of water lifted one foot high by the consumption of 100 pounds of coal.

2—The number of pounds of water lifted one foot high by the consumption of 1,000 lbs. of steam. This latter quantity is taken as the equivalent of 100 pounds of coal, each pound of which is reckoned as evaporating 10 pounds of water into steam.

3—The number of pounds of water lifted one foot high by the consumption of 1,000,000 heat units; this total being the equivalent of 100 pounds of coal, each pound of which will impart 10,000 heat units to the water in the boiler, or whose evaporation from and at 212 degrees Fah. is 10 pounds of water per pound fuel.

The work done in foot pounds is expressed as the area of the pump plunger (corrected for area of pump rod), multiplied by the gross pressure against which the pump is working (measured by pressure gauge on the rising main plus the pressure due to height of gauge above surface of water in well), multiplied by average length of stroke of plunger in feet and multiplied again by the total number of single strokes the pump plunger makes during the trial.

The total number of heat units consumed is found by multiplying the aggregate weight of feed water supply to the boiler or boilers by the total heat of the steam at the working pressure, reckoned from the feed water temperature as a basis and making any necessary corrections for moisture or superheat.

* * *

Question.—How much coal is usually required for banking fires over night, and for raising steam to full working pressure at starting time in the morning?

Answer. — The accompanying data were secured from boiler plant tests, but for this reason the coal burned is perhaps less than the average day-in and day-out amount. "Run of mine coal" was used in the tests.

H.P. Boiler.	Type Boiler.	Banking Coal lbs.	Firing Up Coal lbs.
40	.....H.R.T.	17	...
40	.....H.R.T.	202	...
40	.....Marine	101	...
60	.....H.R.T.	131	...
70	.....H.R.T.	80	270
150	.....H.R.T.	0	800
200	.....Marine	0	785

* * *

Question.—How does steam used for heating purposes in a system where the returns are fed direct to the boiler-feed water pumps compare with that of a receiver?

Answer.—If the whole exhaust is used for heating, then a receiver provides a manner of storing the condensation until it is required for feed-water purposes. Where only part of the exhaust is used for heating, the receiver is of little and even questionable value.

* * *

Question.—What is the equivalent valuation of sawdust or shavings in terms of coal used, if both are fed together to a steam boiler furnace?

Answer.—Much will depend upon the quality of the coal and the character of the wood from which the sawdust and shavings are obtained. A plant large enough to justify separate furnaces for each would prove the more economical method of operation, as the respective furnaces could be adapted to each kind of fuel, instead of being otherwise a compromise.

Steam Power Plant Auxiliaries

BOILER FEED PUMPS—II.

THE chief conditions ragarding installation, service, and operation of boiler feed pumps having been outlined and discussed in the immediately previous article of this series, particular attention will now be given the design and constructional features of boiler feed pump products more or less in evidence in Canadian steam power plant installations, large and small.

"Burnham" Pumps

Burnham pumps are built in Canada by Darling Brothers, Montreal, who supply them in a wide range of sizes and types. The pumps shown in Figs. 1 and 2 are of the simplex, piston type, the former being built in seven sizes from 10 x 6 x 12 inches to 14 x 8½ x 12 inches, and the latter from 12 x 7 x 16 inches to 14 x 9 x 16 inches. A cast-iron yoke is shown connecting the steam and water ends in Fig. 1, this being replaced in the case of the larger pump, with steel tie-rods.

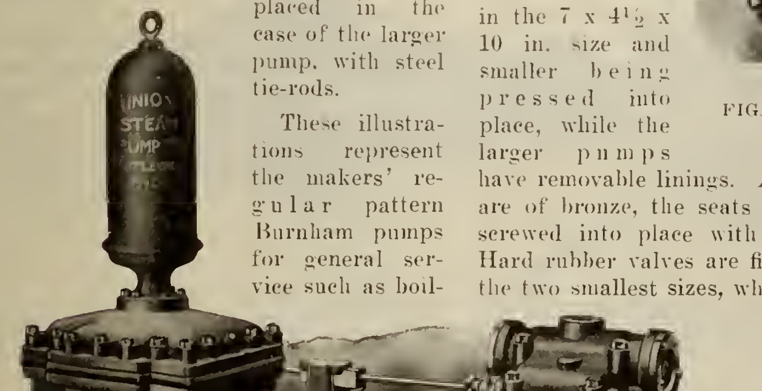


FIG. 2.—"BURNHAM" HORIZONTAL BOILER-FEED PUMP, PISTON PATTERN WITH STEEL TIE-ROD YOKE.

These illustrations represent the makers' regular pattern Burnham pumps for general service such as boiler feeding and other high duty work. They are designed for a water pressure not exceeding 150 lbs. per square inch, are double-acting, and have water pistons designed for square fibrous packing suitable for handling either hot or cold water. They are regularly fitted with solid Tobin bronze piston rods, but the 14 x 8 x 16 and larger sizes are made with two-piece piston rods, of Tobin bronze in the water end and steel in the steam end. The two parts of the piston rod are fastened together by threaded steel clamp coupling on pumps with 14 or 16 inch steam cylinders, and with keyed coupling on larger sizes. This design enables the water piston to be removed with the least trouble.

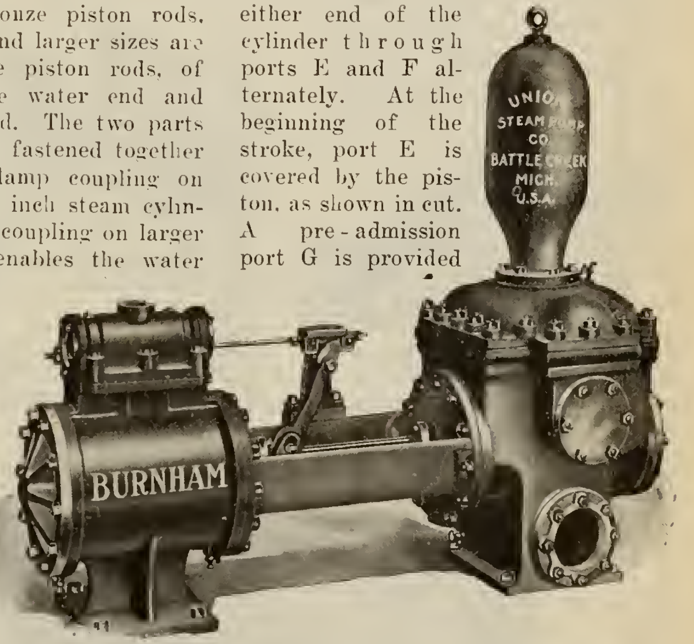


FIG. 1.—"BURNHAM" HORIZONTAL BOILER-FEED PUMP. PISTON PATTERN WITH CAST IRON YOKE.

The water end, which is shown in section in Fig. 4, is provided with heavy bronze linings in all sizes, those in the 7 x 4½ x 10 in. size and smaller being pressed into place, while the larger pumps have removable linings. All valve parts are of bronze, the seats being securely screwed into place with taper thread. Hard rubber valves are fitted except on the two smallest sizes, which are always built with brass valves.

The steam cylinders have a removable steam chest, the valves being flat-faced D type, and capable of being readily rescraped to a tight fit when worn. The main steam piston and steam chest piston are equipped with expansion rings. Sectional views of the steam cylinder chest and valves are shown in Fig. 3. The upper view is a plan showing auxiliary valve and chest, and the lower is a vertical section through the cylinder. Live steam enters chest at B and is admitted to either end of the cylinder through ports E and F alternately. At the beginning of the stroke, port E is covered by the piston, as shown in cut. A pre-admission port G is provided which admits only enough steam to give the piston an easy start. When the main piston has moved far enough to uncover the port E, it receives the full steam pressure and moves at its normal speed until it covers the port F, when it traps the remaining exhaust steam in the end of the cylinder, thus forming a cushion which brings the rod to an easy stop.

The gear is positive in action and is operated by a slotted lever A, moved by a roller attached to the piston rod. The pin which carries the roller is fastened to the piston rod by a split coupling, the other half of which is forked and extends over to the yoke where it engages with an internal rib or tongue as shown. This prevents the piston rod from turning, and causes the roller to travel in a straight line irrespective of the angle at which the lever A may be. This lever A. alternately moves blocks K and L, both of which are fastened to valve stem T, which in turn moves auxiliary valve H (upper view) in the direction opposite to the motion of the piston.

At the end of the stroke, the auxiliary

valve H will be moved to the left far enough to open port P to exhaust through R, at the same time admitting live steam through port C. This causes steam chest piston M to move instantly, carrying main valve D with it, and reversing the motion of the pump. The steam chest piston has a pair of pre-admission ports similar to those described above for the main piston, and are for the purpose of giving a steam cushion to insure a quiet action. Blocks K and L are independently adjustable on rod T, enabling the engineer to make the piston run as close to the heads as he desires, and to make adjustment for wear. By moving block K 1-16 in. nearer to lever A, the main piston E will be stopped perceptibly earlier in its travel toward end of cylinder as shown, while similar adjustment of block L affects the piston travel in the opposite direction.

The advantages of this valve gear may be summed up as follows: A momentary pause of the piston at the end of each stroke, causing the water valves to seat quietly without shock or jar; a slow initial movement of the piston, whereby the water columns are started gradually, relieving the pump and piping of undue strains; a steam pressure on the main steam piston proportioned to the amount of work that it has to do; and immunity from damage in case of accident.

A compound steam pump of the Burnham type is illustrated in Section, Fig. 4. These pumps are made in a wide range of capacities with nine sizes of steam ends, from 6⅛ in. and 8½ in. diameter x 10 in. stroke to 24 in. and 36 in. diam. x 24 in. stroke. Equipment consists of counter, force-feed oil pump, and lagging on steam cylinders and steam chests, hand plates being fitted for access to water-valves. Being a sectional view there is shown method of coupling up the valve mechanism so that the steam supply for the two cylinders is controlled by the one auxiliary valve. The steam chest piston for the low pressure cylinder is provided with a spindle which is coupled as shown to a similar spindle on the high pressure steam chest piston. In this way the single auxiliary valve H, Fig. 3, is used to control the steam supply to both cylinders, which are connected by a substantial yoke of sufficient length to provide room for packing the two piston-rod stuffing boxes. Both the steam pistons are equipped with expansion rings—the low pressure piston being screwed tightly on to the piston rod and pinned in place, after which it is turned true. The high pressure piston has a tapered fit on the end of the piston rod, and is held in place with lock nuts.

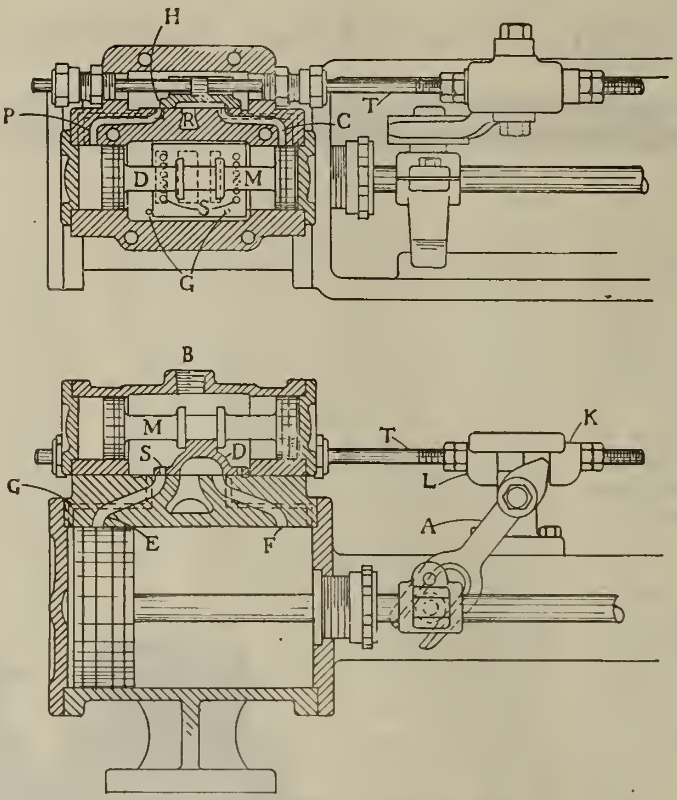


FIG. 3.—SECTIONAL VIEW OF STEAM END SHOWING CYLINDER CHEST AND VALVES.

With a compound pump of any type, the steam is used expansively. This cannot be done in a simple pump. A reduction of about 35 per cent. in steam consumption is obtainable as compared with a simple pump under similar conditions. This increased efficiency is accompanied by the ability to increase the water pressure from 50 to 70 per cent. in case of emergency by supplying live steam direct into the low-pressure cylinder through a valve provided for the purpose.

Double-acting plunger pumps are shown in Figs. 5 and 6, the former being known as the outside end-packed type, and the latter as the outside centre-packed type. Regarding Fig. 5, this pump is adapted for general use with water pressures not exceeding 150 lbs. per sq. in. The plungers are of cast iron with steel side rods. On the 7 in. size and larger, the plunger heads are made separate from the plungers, which allows them to be removed without disturbing either cylinders. As the plungers receive all of the wear on their exterior surface, to put a worn pump in good shape, it is only necessary to turn up the plungers in a lathe. As the piston rod does not enter the water cylinder it is made of steel.

The plunger pumps shown in Fig. 6 are designed for use at a pressure of 180 lbs. per sq. in. The plunger is submerged on both ends and packed on the outside at the centre. Tobin bronze is employed for the water piston rod which is secured to the steel rod in the steam end by a heavy threaded clamp coupling. Ample space is provided between stuffing boxes on the water cylinder for packing the pump plunger.

The stuffing boxes on all types of these plunger pumps, 12-in. and under, are made for ¾ in. packing; on the larger sizes 1 in. packing is used. Pumps larger than 4 in. have the plunger glands fitted with special wick-filled lubricating grooves and lubricators which oil the entire surface of the plunger at each stroke.

The general features of these plunger pumps are similar to the pis-

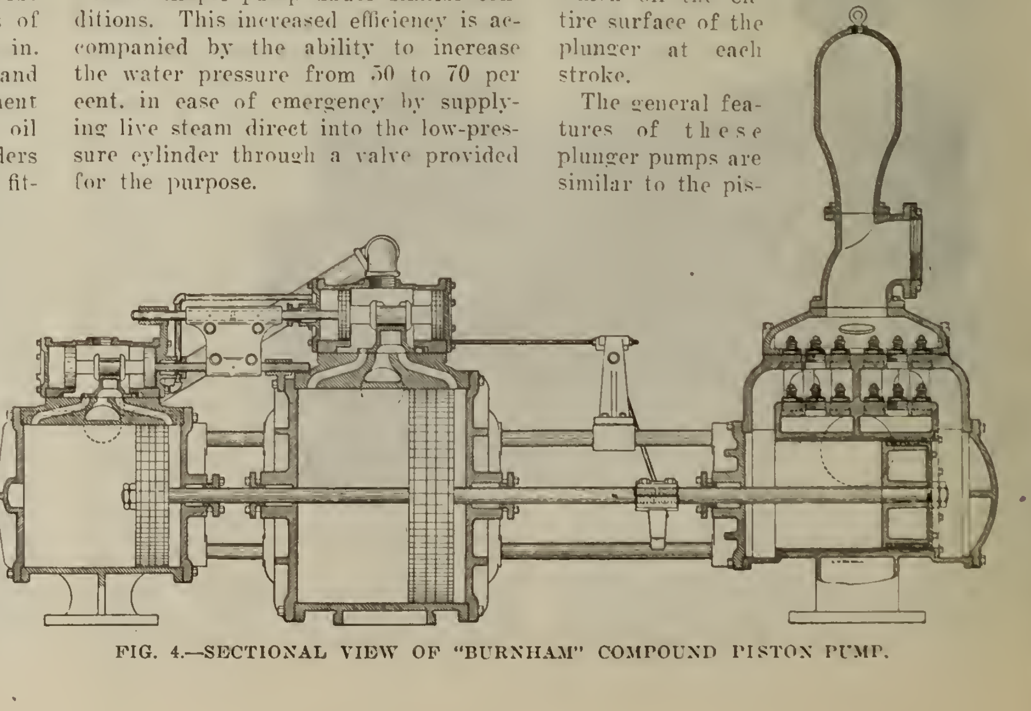
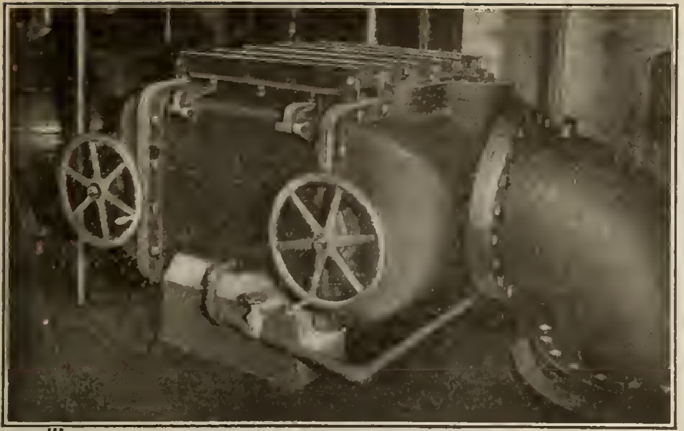


FIG. 4.—SECTIONAL VIEW OF "BURNHAM" COMPOUND PISTON PUMP.



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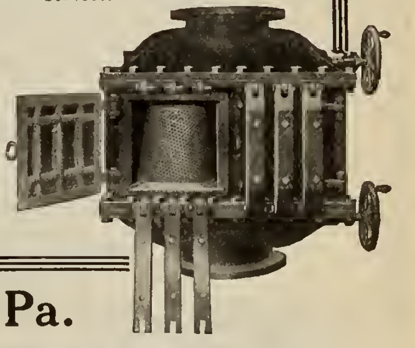

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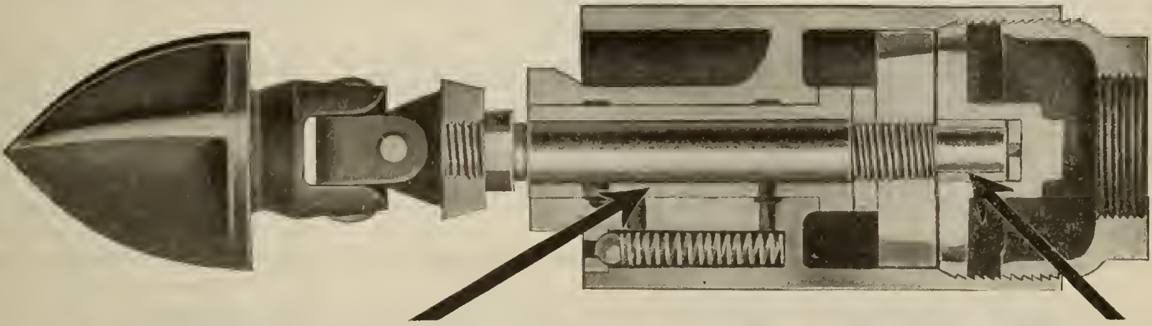

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ton type. Hard rubber valves, bronze springs, valve seats, plates, and valve stems being to standard specifications in all sizes.

'Weir Pumps''

The Weir standard feed pump for land installations, shown in Fig. 7, is built by G. & J. Weir, Ltd., Glasgow, Scotland, who are represented in this country by Peacock Brothers, Montreal and Vancouver. This pump is of the slow-speed, direct-acting type, which has been developed by the makers over a period of 25 years. The reputation for economy and long life enjoyed by this apparatus is due to the peculiar design of valve employed. The valve gear is positive, i.e., the steam valve can never be in such a position that the pump will not start immediately steam is turned on. The numbers on Fig. 7 refer to the following list of parts:—(1)—Steam slide valve chest; (2)—Double joint, etc.; (3)—Front stay; (4)—Bottom spindle; (5)—Valve gear levers; (6)—Front stay bush; (7)—Ball crosshead; (8)—Main crosshead; (9)—Crosshead pin; (10)—Piston rod; (11)—Piston body; (12)—Piston rings; (13)—Cylinder cover; (14)—Discharge valve seat; (15)—Discharge valve seat ring; (16)—Suction valve seat; (17)—Suction valve guard; (18)—Discharge valve guard; (19)—Water valve; (20)—Bucket; (20a)—Bucket rings; (21)—Pump rod; (22)—Pump cover; (23)—Valve chest covers; (24)—Steam stop valve; (26)—Auxiliary valve spindle; (27)—Cylinder neck ring; (28)—Cylinder gland; (29)—Pump neck ring; (30)—Pump gland.

Number and Names of Parts Shown on Fig. 5.

2	Outside Steam Cylinder Head.
2A	Inside Steam Cylinder Head (for yoke).
6	Steam Piston.
37	Steam Cylinder Rings.
39	Steam Cylinder.
19	Steam Valve Chest.
20	Steam Valve Chest Heads.
21	Steam Chest Piston.
37A	Steam Chest Cylinder Rings.
104	Main Slide Valve.
105	Auxiliary Slide Valve.
36	Stuffing Box Gland for Piston Rod (Steam Cylinder), iron.
105½	Valve Stem Rod.
111A	Collars on Valve Stem Rod.
101	Auxiliary Valve Stem Stuffing Boxes.
102	Auxiliary Valve Stem Stuffing Box Nuts.
103	Auxiliary Valve Stem Stuffing Box Glands.
106	Actuating Lever.
106½	Actuating Lever Rod.
108	Standard for Actuating Lever.
109	Right and Left Cam Blocks on Valve Stem.
110	Bolt for Holding Actuating Lever.
111	Guide for Actuating Lever Rod.
112	Stud Bolt to Hold Guide for Actuating Lever Rod.
116	Clamp to Hold Standard for Actuating Lever.
68	Tie Rods.
44	Water Cylinder.
47	Water Valve Plate.
48A	Water Cylinder Hood.
18	Air Chamber.
34	Air Chamber Plug.
15	Water Valves.
58	Water Valve Seats.
48	Water Valve Bolts.
86	Water Valve Springs.
4	Plungers.
36A	Stuffing Box Glands for Water Plungers.
12	Piston Rod.
100	Side Rods.

As regularly supplied, these pumps have cast iron steam cylinders covered with planished sheet steel, supported by steel columns on a cast iron pump cylinder fitted with gunmetal liner. In the smaller sizes a one-piece cold-rolled manganese bronze rod is used, the larger sizes having a steel rod for the steam end. Valves and valve seats are of bronze with gunmetal guards. The steam piston is of standard design, and the water piston is of gunmetal fitted with special ebonite packing rings, except when dealing with feed water over 190 deg. F., in which case it is made entirely of gunmetal.

Chief interest in this pump centres around the steam distributing valve. Detail views of the steam slide valve and chest are given in Figs. 8, 9, 10 and 11. The steam chest contains a main and an auxiliary valve. The main valve A distributes steam to the cylinder. The auxiliary valve B has two functions: it distributes steam to work the main valve; and its outer edge cuts off steam entering the main ports C and D leading to the top and bottom of the cylinder.

Both valves are of the simple slide type, but the main valve is half round, the round side working on the chest face, which is bored to fit. On the back of the main valve a flat face is formed upon which the auxiliary valve works. On this face, the ports C, D, E, F are cut, with the exhaust port H in the centre. The ends of the main valve are cylindrical, and project beyond the port

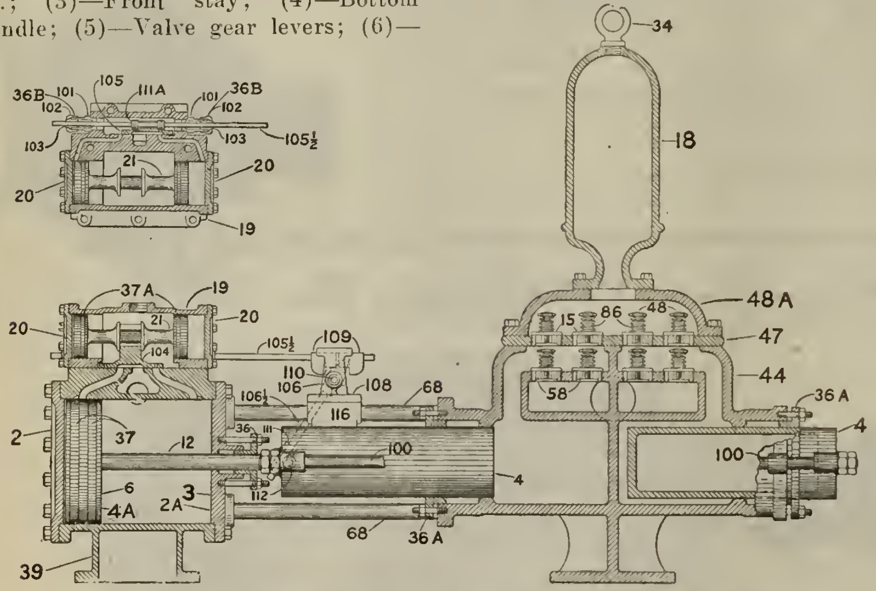

FIG. 5. SECTIONAL VIEW OF "BURNHAM" DOUBLE ACTING, OUTSIDE-END-PACKED PLUNGER PUMP.

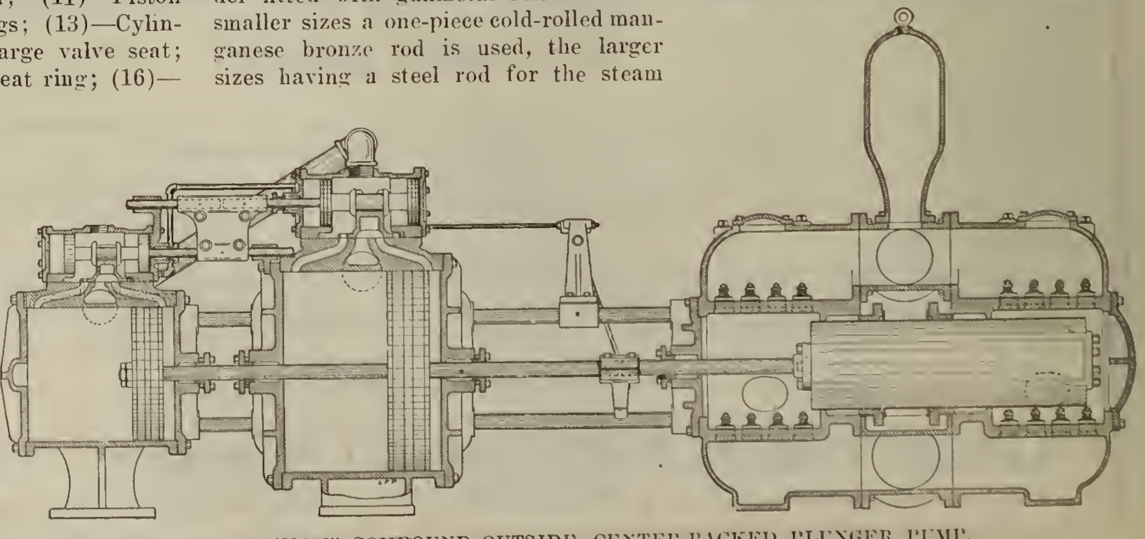

FIG. 6 "BURNHAM" COMPOUND OUTSIDE CENTER PACKED PLUNGER PUMP.

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face. They are fitted with loose bells or cylinders in which the valve works. These bells are held in position by the end covers and by faces cast on the chest for the purpose. The operation of the valves during a double stroke of the pump is as follows:—

When the piston is at the bottom of the stroke, the main valve is in the right-hand position, and the port C leading to the bottom of the cylinder is open to the steam pressure. This port remains open until the piston reaches half-stroke, when the auxiliary valve B begins to move in the same direction as the piston, and at about three-quarters stroke the auxiliary valve closes the port C leading to bottom of cylinder. The remainder of the stroke is completed by the expansion of the steam already shut in the cylinder, or by more steam admitted through the by-pass, which will be described later.

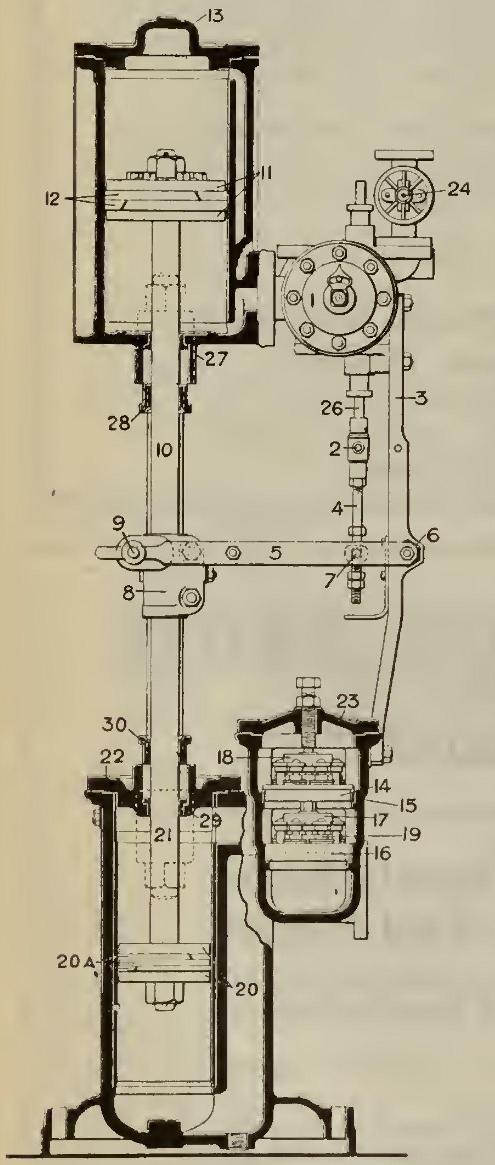


FIG. 7. SECTIONAL VIEW OF WEIR STANDARD VERTICAL FEED PUMP.

When the piston reaches the end of stroke, the auxiliary valve opens the port E leading to the left-hand end of the main valve. The other end in this position is open to the steam through the port F, and the main valve is thrown over until the exhaust steam from the left-hand end of the main valve is cut off; this exhaust steam acts as a cushion and prevents the main valve from hitting the end cover. The main valve is now at the opposite end of its stroke, and the port C which admitted steam to move the piston on the up stroke, is open to exhaust. The port D leading to the top of the piston is now open to steam.

The action described above takes place also on the down stroke; the main piston travelling half its stroke before beginning to move the auxiliary slide, which again cuts off steam at about three-quarters of the stroke. The remainder of the stroke is travelled by the expansion of the steam in the cylinder, or by fresh steam admitted through the bye-pass.

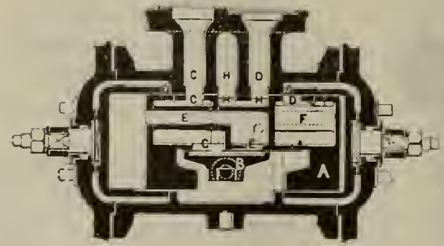


FIG. 8. WEIR STEAM VALVE, SECTIONAL PLAN.

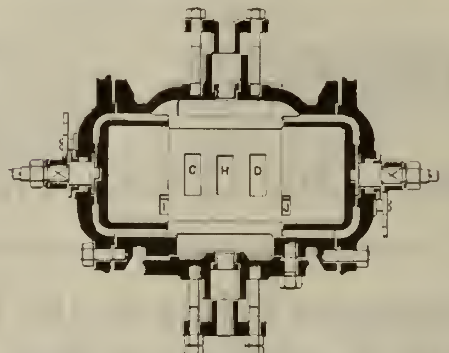


FIG. 9. WEIR STEAM VALVE SECTIONAL FRONT ELEVATION SHOWING BY-PASS PORTS J.

Under certain conditions the pump will not complete its stroke by the expansion of the steam in the cylinder; for instance, if the pump were started with the cylinder cold, the steam would rapidly condense and fall below the pressure necessary to move the piston. In such circumstances it is necessary to admit steam after the auxiliary valve is closed to main ports C and D on the face of the main valve, and this is done by means of the by-pass on each end of the chest. These by-passes, I and J, are made by cutting a port on each of the bells and a corresponding port on the back of the main valve. Provision is made on each end of the steam chest for opening and closing the ports by hand.

The main valve is not, as might appear from its shape, a piston valve: it is an ordinary slide valve and must, therefore, be kept tight by facing up in the usual way. It is important that the bars between the steam and exhaust ports should have a good bearing, as, if this bearing is properly maintained, wear and tear on the valve is reduced to a minimum. If, on the other hand, steam is allowed to leak past the bars, it soon cuts them away. In filing the valve face, care must be taken to file only the length of the valve travel. If the valve face is filed out to the ends the valve will no longer fit the bells accurately and its efficiency will be impaired. There is very little wear on the ends of the main valve, but if in the course of time the ends of the valve become slack in the bells, Ramsbottom rings may be fitted to ensure a steam-tight fit.

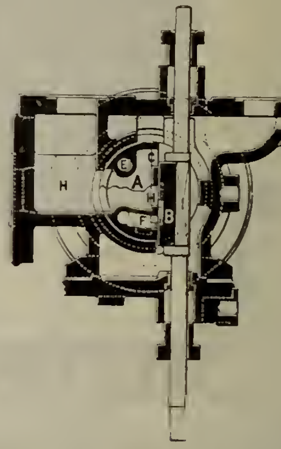


FIG. 10. WEIR VALVE GEAR, SECTIONAL SIDE ELEVATION.

The auxiliary valve holds the main valve up to its face, and it may, therefore, be necessary, after bringing up the bearing, to put a liner between the valve spindle and back of auxiliary valve to hold it up. After lining up, move the main valve backwards and forwards by hand to ensure that it is not too tight. The face on the auxiliary valve must also be kept in good order.

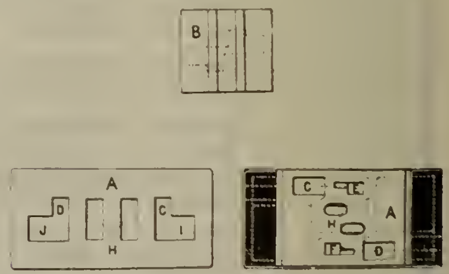
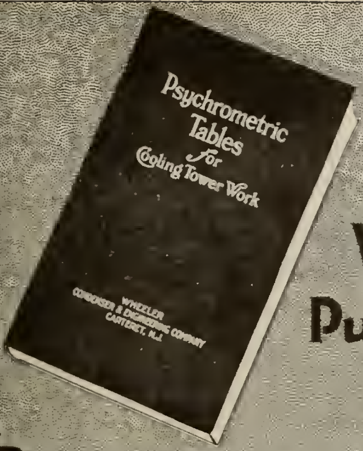


FIG. 11. UPPER—AUXILIARY VALVE. LOWER LEFT—MAIN VALVE FACE. LOWER RIGHT—FACE ON BACK OF MAIN VALVE FOR AUXILIARY VALVE.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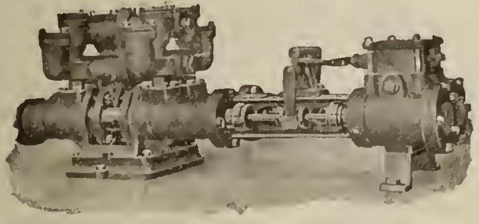

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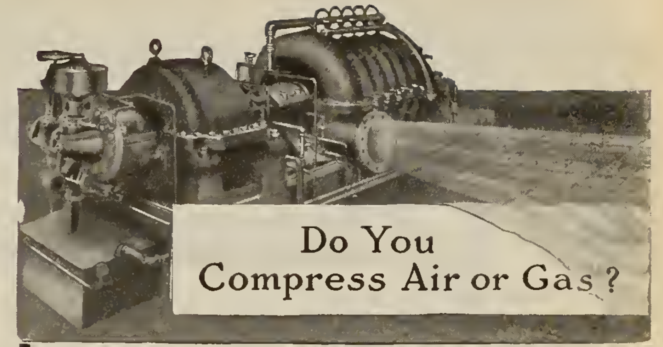

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Progress in New Equipment

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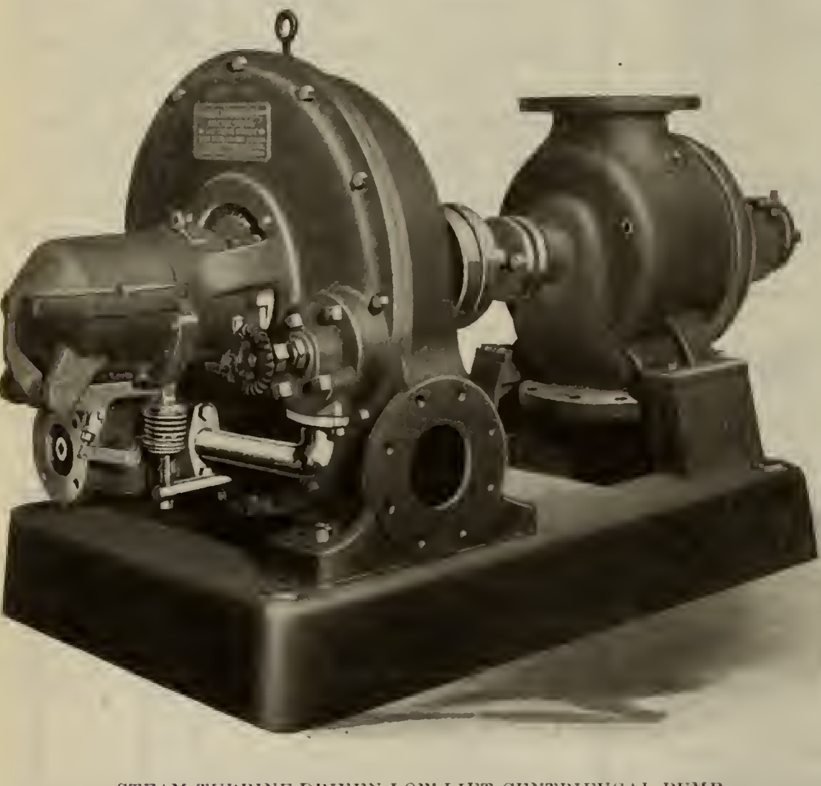
THE illustration shows a low lift centrifugal, turbine-driven pump recently supplied to the Canadian Salt Co., Windsor, Ont., by the Goldie & McCulloch Co., of Galt, Ont., for condenser service in connection with the 800 k.w. triple expansion, vertical quick revolution engines also supplied by the same concern. It is capable of delivering 1,000 U.S. gallons per minute against a total head of 40 feet when running at approximately 2100 r.p.m. Under these conditions the makers of the pump guaranteed an efficiency of 60 per cent. with a maximum b.h.p. of 16.85 at pump coupling. A flexible coupling connects the pump to a steam turbine of 20 b.h.p. when operating at about 140 pounds gauge and with back pressure of 5 lbs. gauge.



STEAM TURBINE-DRIVEN LOW-LIFT CENTRIFUGAL PUMP.

The pump is of the Rees-Roturbo pattern, the design of which is exceedingly simple, consisting of a pressure drum rotating in a casing at moderately high speed. This pressure drum is mounted on a central horizontal shaft mounted in ring-oiled, babbitted bearings. There are no moving parts in contact except at the bearings, and the whole of the internal arrangements are such that the group is in hydraulic balance. The packing arrangements are also exceedingly simple.

When running, the water gravitates, or is drawn into the eye of the revolving pressure drum where it is stationary relative to the drum. The water is carried round by the revolving partitions, and a pressure is created in the revolving drum by the centrifugal action of rotation. The capacity of the drum being large the water slowly moves toward the periphery where are located a number of short nozzles curved in a direction opposite to the direction of rotation. These nozzles convert a portion of the pressure into velocity and the water passing through them behaves as in a water turbine, assisting the rotation of the revolving drum and thereby giving self regulating effect. The escaped water still having velocity in the direction of rotation is passed between stationary diffusion channels which convert the remaining velocity into pressure.

The special feature of the pump is the construction of the impeller which instead of being built as a flat disc runner with the main object of securing velocity of water in the expanding channels of the fixed casing, is designed in the form of a barrel or pressure chamber, the object aimed at being to secure a constant pressure inside the revolving drum or impeller equivalent to the height of the lift. The impeller having this large capacity, the water inside as it approaches the rim becomes practically stationary relatively to the impeller, thus eliminating all friction losses and generating a pressure by centrifugal force which is the main feature of the patent.

The steam turbine in this set was also made by the Goldie & McCulloch Co., who supply this same type for both pumping and electrical units. The working principle of this turbine is described in connection with the pumping installation at the Hospital for the Insane, Whitby, also appearing in this issue. In these smaller power units not more than two nozzles are needed, one being directly in series with the throttle governing valve, while the other one may be controlled by means of a hand valve. As in the other types the latter constitutes an auxiliary valve for use when the load increases over the capacity of the main nozzle which is usually designed to carry approximately full load. The governing mechanism and carbon stuffing rings are similar to those used on the larger power units and the same care is taken in the balancing and overspeed testing. These turbines are supplied either of vertical or horizontal split pattern.

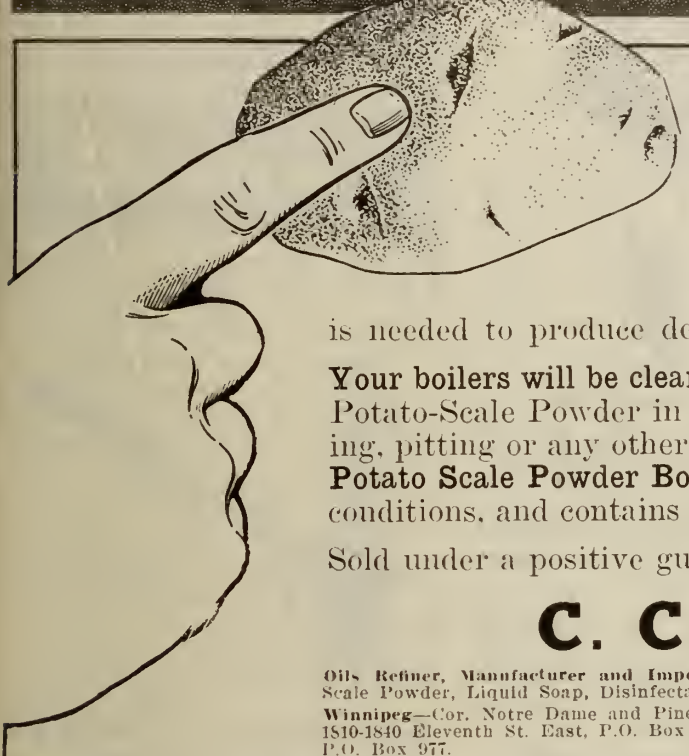
* * *

PORTABLE ELECTRIC HOIST

THE accompanying illustration shows a portable electric hoist designed for use in locations where it can be suspended by a single hook, or when required can be attached to an overhead trolley or crane and moved from place to place.

Owing to the limits imposed on such machines by the requirements of porta-

Potato Scale Powder Boiler Cleanser



Makes and Keeps Boilers New in Efficiency and Economy

You cannot afford to let scale accumulate in your boilers because it reduces their efficiency, which means a larger amount of fuel is needed to produce desired steam pressure.

Your boilers will be clean all the time if you use a small quantity of Potato-Scale Powder in your feed water daily—there will be no foaming, pitting or any other troubles due to impurities in the feed water. **Potato Scale Powder Boiler Cleanser** is made to suit your feed water conditions, and contains nothing injurious to tubes or fittings.

Sold under a positive guarantee. **Try a barrel.**

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384. P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 977.

It's the cartridge of a fuse that costs—why discard it when the inexpensive refill blows?

Two minutes time and a renewal element makes a new fuse of the blown

Monarch Refillable

MONARCH REFILLABLE FUSE
A Sure Contact

Monarch Refillable Fuses cost but little more than the ordinary kind—the renewals a mere trifle.

Illustration shows Knife Blade Type with one end cut away to disclose the method of forming the contact between the fuse ribbon and the blade.

The Monarch Refillable Fuse is constructed with all parts Die Stamped, making the parts accurate and interchangeable, thereby making the *refilling very simple,* as the different parts will fit either cap. Our *Spring Gripping* contacts are made of copper, assuring proper carrying capacity and cooling surface.

When you buy Monarch Refillable fuses you get *efficiency, reasonable price* and *prompt shipment.*

WRITE FOR CIRCULAR GIVING FULL DESCRIPTION.

Dealers and Agents in open territory will find it worth their while to investigate our proposition.

The Monarch Refillable Fuse Co.
Hamilton, Canada

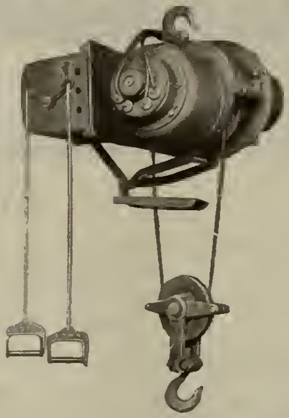
bility and compactness, the makers have used straight standard cut spur gears throughout. These gears are forged steel, heat treated, and completely enclosed, permitting ample lubrication during operations. An enclosed mechanical disc brake and a motor brake are used on all sizes. An automatic limit device stops the hook at top of lift.

The Northern Crane Works, Ltd., Walkerville, Ont., supply these hoists in a variety of types for use with either alternating or direct current.

Trade Gossip

Montreal, Que.—The Board of Control has awarded the contract for the installation of a pump at Papineau Avenue pumping station to the Canadian Allis-Chalmers, Ltd.

Calgary, Alta.—The City Commissioners have awarded a contract to the Canadian Westinghouse Co., for electrical apparatus for the city power house at $9,770.



PORTABLE ELECTRIC HOIST.

Lethbridge, Alta.—The City Commissioners have decided to purchase a motor-driven fire pump.

Sarnia, Ont.—The City Council has accepted the tenders of Mackenzie, Milne & Co., the H. Mueller Mfg. Co., and the National Iron Works for supplies for the waterworks.

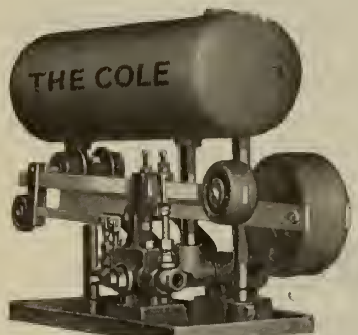
Ottawa, Ont.—The City Council have awarded the following contracts: Pipe, The National Ironworks Ltd., Toronto; valves, McDougalls Ltd., and General Supply Co., Ottawa; brass work, the General Supply Co.

John Collins has been appointed general manager of the Canadian Steam Boiler Equipment Co., Toronto, manufacturers of the "Cyclone" shaking and dumping grate bar. Mr. Collins was formerly supervising engineer with Gillespie Bros., Toronto.

The Toronto Transmission Co., have equipped a plant at 840 Dundas St., Toronto, for making general transmission machinery, such as hangers, clutches, pulleys, etc. Fred K. Robinson, formerly sales manager with the Dodge Co., Toronto, is manager of the new concern.

The Consolidated Engineering Co., Chicago, Ill., have purchased the complete plant of the Massachusetts Fan Co., Watertown, Mass. John E. Anderson, late with the B. F. Sturtevant Co., Boston, Mass., will be in charge of the heating and ventilating department

Fraser & Chalmers of Canada, Ltd., of Montreal, have recently been awarded the contract by the City of Regina, covering the delivery and erection of a 300 h.p. steam turbine, direct connected to two centrifugal pumps, having a total capacity of seven million Imperial gallons per twenty-four hours.



"COLE"
AUTOMATIC
BOILER FEEDER

will return condensation to your boilers over 100° higher than is possible with a pump.

THE RESULTANT SAVING of FUEL is ENORMOUS.

The good circulation ensures efficiency.

Operates on roller bearings, on a fixed fulcrum, which permits a full discharge at each operation.

Operates on 1-10th the steam that it takes to run a steam pump.

Are you interested? If so, drop us a line, and we will explain more fully.

Geo. W. Cole Co.
838 Dundas St., Toronto, Ont.

Classified Advertisements

WANTED

WANTED—2-300 H.P. BOILERS, TESTED for 150 lbs. pressure, with or without stokers; must be in first-class condition; Eastern Canada location preferred. Reply to "Boilers," care of The Power House. (rtf)

FOR SALE

FOR SALE—TWO HORIZONTAL RETURN tubular boilers 60" x 16', built to comply with Ontario Government specifications. Made in St. Catharines for a special order. Full particulars and details upon application to Taylor-Forbes Co., Ltd., Guelph, or Taylor-Forbes Co., 1088 King Street West, Toronto.

USED POWER EQUIPMENT.
ENGINES.
75 H.P., 16 x 36 Leonard Corliss, used less than year; heavy duty type.
85 H.P., 13 x 30 Brown automatic, excellent condition.
75 H.P., 12 x 30 Inglis Corliss
75 H.P., 12 x 12 Robb high-speed.
20 H.P. Robb high-speed.
BOILERS.
72 x 18 horizontal return tubular, shaking grates, Government Inspected.
GENERATORS AND MOTORS.
200—300-light dynamos.
20, 25, 35, 250-volt motors.
50 H.P. gas engine and producer, good as new, at great bargain.
Hobbs & McGill, Mail Building, Toronto, Ont.

Fetherstonhaugh & Co.
Patents
Trade Marks and Designs in all countries
Canada Life Bldg., MONTREAL

U.S. METAL POLISH
Works Equally Well on Hot and Cold Surfaces. It Cannot Blow Up. Cleans, Polishes and Preserves all kinds of metals.

Tear this off as a reminder

Geo. Wm. Hoffman Co.,
557 E. Wash. St.
Indianapolis, Ind.

Enclosed find 10c in stamps, for which send me one large 50c can of U. S. Metal Polish Paste.

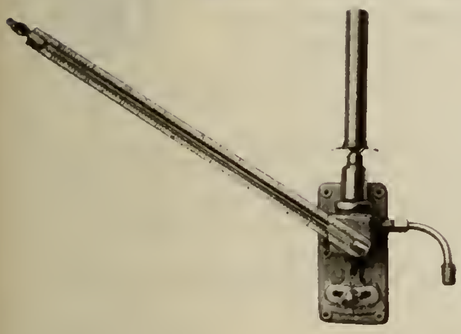
Name ....
Address ....
....

WALTER J. FRANCIS, C.E. M. Can. Soc. C.E., M. Am. Soc. C.E., M. Inst. C.E.
FREDERICK B. BROWN, M.Sc. M. Can. Soc. C.E., Mem. Am. Soc. M.E., Mem. A.I.E.E.
WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

Designer and builder of power and manufacturing plants, abattoirs, cold storage and packing house equipments. Factories constructed on the economy fire-proof plan. Ice-making plants and refrigeration installed.

GEORGE SCHAUTZ
Mechanical Engineer
BUFFALO, N.Y.
Office: 346 Ellicott Sq. Bell Phone, Seneca 3613-R.
Residence: 686 South Side Parkway
Bell Phone, Abbott 665-W.

Universal
LIQUID
MEASURING
Devices



THE above cut is simply one of many types of measuring instruments, and we will be glad to supply instruments covering any class of liquid measuring on receipt of the following data:

1. **S.P.G. of Liquid to be measured.**
2. **Depth of container.**
3. **Approximate location of container from Instrument.**
4. **Scale per foot of depth required on the instrument.**
5. **Maximum and minimum depths of liquid to be measured.**
6. **Whether the tank is exposed to frost.**
7. **Whether tank is vented.**

On receiving information we will advise on best type of instrument.

This instrument measures the quantity of water or other liquid in a tank, well, stream or in almost any situation, and is absolutely free from mechanical devices, except for a small air pump at the instrument itself.

ALWAYS READY, ALWAYS SURE — ALWAYS KEEPS YOU POSTED ON THE QUANTITY OF LIQUID ON HAND, SAVES MUCH TIME AND PREVENTS "RUNNING SHORT."

Can be placed close to or far away from the liquid. It does not matter where the liquid to be measured is in relation to the device, as all you have to do is to run a piece of ¼ in. pipe from the tank to the instrument and the tank may be below or above ground, or hundreds of feet from the instrument, which latter is placed at any convenient position in the office or desired room.

Drop a line for circular and full particulars.

UNIVERSAL MEASURING DEVICES, Limited
125 ISABELLA STREET, TORONTO

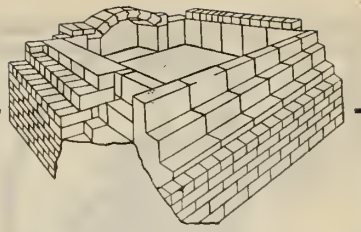
Catalogues

Cold Storage Doors.—The Jamison Cold Storage Door Co., Inc., Hagerstown, Md., have issued a bulletin dealing with the "Jones" and "Noequal" doors for cold storage installations. The principal constructional features of these doors are described and illustrations show the general design.

Nonpareil Corkboard Insulation, is the title of a catalogue being issued by the Armstrong Cork & Insulation Co., Ltd., Montreal, Que. The catalogue deals with the production and application of cork for insulating purposes and contains a great deal of interesting information of both a practical and scientific value. A number of pages deal with the heat conductivity of "Nonpareil" corkboard and other insulating materials and also includes reports on tests of these materials. The fire-resisting properties of "Nonpareil" corkboard are described, accompanied by illustrations, showing fire tests and a number of installations of this material. Several specifications for erection covering various types of building are included with sectional diagrams showing the corkboard construction. The concluding pages deal with miscellaneous uses for "Nonpareil" corkboard, illustrated. This is a high class catalogue containing a considerable amount of useful information for refrigeration engineers. The press work is good and the illustrations are very clear.

Book Review

Engineering as a Career.—Edited by F. H. Newell, Professor of Civil Engineering, University of Illinois, and C. E. Drayer, secretary Cleveland Engineering Society, 226 pages, 5 in. x 7 in., published by the D. Van Nostrand Co., New York, price $1.00 net. This book consists of a series of papers prepared by eminent engineers and presents for the guidance of young men and their advisers some of the facts usually hard to obtain concerning engineering as a life work. The choice of a vocation is as a rule a most difficult problem to solve for at the time when the decision has to be made, the boy or young man has little idea as to what will be required of him in his work. The same remark often applies to parents who cannot always judge what career the boys' qualifications are best suited for. The engineer who has written these articles endeavors to explain what he believes to be the personal and educational qualifications required, for success, and what opportunities await the young man who chooses engineering as a career.



Gates Boiler Furnace
Patent Applied For

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

—WRITE FOR PARTICULARS.—

John W. Gates 382 St. James St. Montreal, Que.

July 27, 1914.

In reply to yours of the 25th inst., will state I have used the Homestead valve as a blow off valve over 15 years in three different plants and they have given the best satisfaction. There are five in our plant now for 13 years. When three of them were 12 years old I had them reground at a small expense and I don't see any reason why they should not last 12 years more; they are the regular 2" size and are opened every day in the year and closed at 100 lbs. pressure and never fail to be tight.

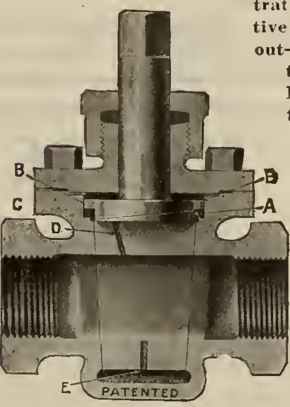
Reed & Barton,
L. W. Stillwell, Ch. Engr.

An excellent example of HOMESTEAD VALVE SERVICE

Made in Straightway, Threeway and Fourway patterns, and for all purposes. Special valves for special purposes.

Simple in construction, easy to operate and the only valve which will successfully stand up under the heaviest duty service.

A finely illustrated descriptive circular just out—it will pay to get one. It's yours for the asking.



Homestead Valve Mfg. Co.
Works:
Homestead, Pa., Pittsburgh, Pa.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

To Manufacturers, Dealers and Users of Steam Boilers

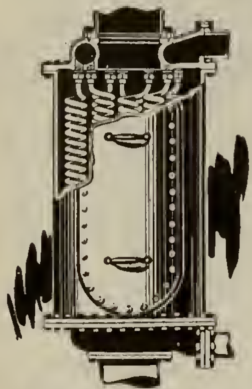
All steam boilers built in, or entering the Province of Ontario, and boilers exchanged or repaired are subject to Government Inspection as prescribed in the Steam Boilers Act, 3 George V., C. 61.

Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department, stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the Regulations by an Inspector authorized under the Act.

All communications should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G. MACDIARMID,
Minister of Public Works.

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

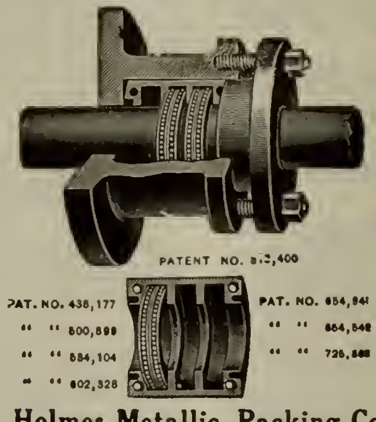


Reilly Multicoil Feed Water Heater

Has greater capacity per square foot of heating surface than any other type of closed heater. It is simple in construction, light in weight and small in size.

Write for Bulletin No. 210.

Canadian Griscom-Russell Co., Ltd.
960 St. Paul Street, Montreal, Quebec



Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

NOTICE

TO

Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

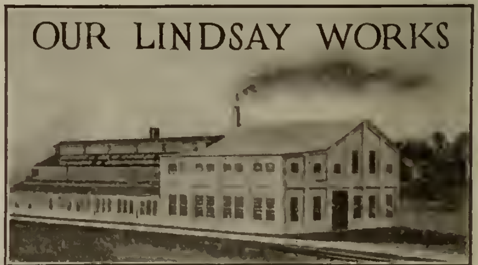
Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. JAS. S. DUFF,
MINISTER OF AGRICULTURE.

W. C. McGHIE,
CHAIRMAN OF BOARD.

Water Turbines, Hydraulic Governors, Centrifugal Pumps



Boving Hydraulic & Engineering Co., Limited
LINDSAY, ONTARIO

McDANIEL IMPROVED **STEAM TRAP**

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.

THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.
WATSON & McDANIEL CO.
No. 146 N. 7th Street, PHILADELPHIA, Pa

Lanco Balata Belting

STRETCH

There are Drives Where Much Stretch is Serious. LANCO BALATA BELTING is as Nearly Stretchless as it is Possible to Have a Good Belt. *Are You Using it.*

FEDERAL ENGINEERING Co., Ltd.
Toronto Montreal

THIS SPACE
$6.25 PER INS. ON
YEARLY ORDER

DARLINGS STEAM APPLIANCES

DARLING BROTHERS
LIMITED
Engineers and Manufacturers
MONTREAL, CANADA

Branches: Toronto and Winnipeg
Agents: Halifax, St. John, Calgary, Vancouver

AN INCREASED INCOME

WE are in need of a representative in your district to look after our subscription business for MacLean's and The Farmer's Magazines. We will pay good money to the man who can produce the right kind of results. The position is one that carries with it a good salary for a man who has energy, enthusiasm and abilities. Just what this salary amounts to depends on how much time is devoted to the work.

ONE of our Toronto representatives during the week of March 13th cleared $20.00 in cash. He averaged four hours a day for four days; you can do as well after becoming acquainted with the plan. For full particulars write us a line and let us tell you how hundreds of representatives are turning their spare time into money. No obligation, just say "Show me how I may increase my present income."

THE MACLEAN PUBLISHING CO., LIMITED
143-153 University Ave. TORONTO, Canada

BABCOCK & WILCOX LIMITED

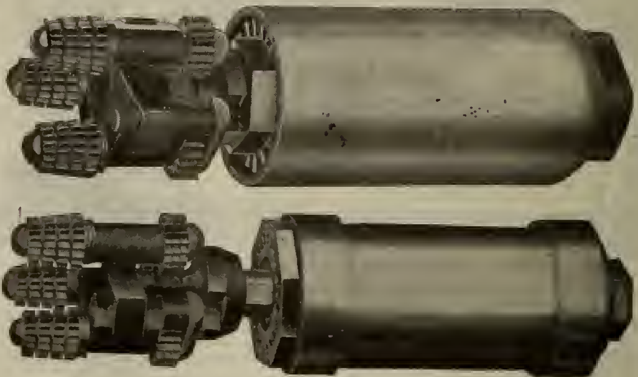
LAGONDA

BOILER TUBE CLEANERS

The latest Lagonda Water and Air-Driven Boiler Tube Cleaners are the most powerful and efficient tube cleaners made. They develop higher speed and greater power than has heretofore been secured with any Turbine Cleaner, and their use will materially shorten the time required in cleaning boilers.

These new Lagonda Cleaners are built for all sizes of tubes, either straight or curved, and they can be driven by water, air or steam.

Ask for Catalog L-8.



LAGONDA Multiple Water Strainers

The Lagonda Multiple Water Strainer in your water supply main will remove all objectionable solid matter and insure constant and economic conditions of pump and condenser operation. They are easily and quickly cleaned, without interruption of water supply, and take up small floor space. **Ask for Catalog R-2.**

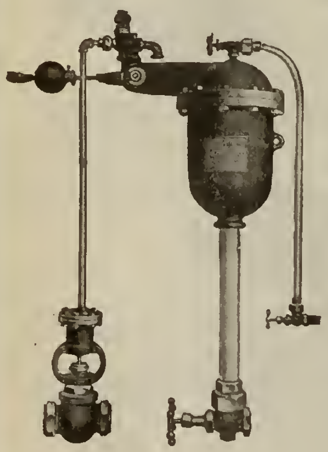
BABCOCK & WILCOX LIMITED

St. Henry, MONTREAL

Branch Office: Traders Bank Building, Toronto

Let the Vigilant

Control Your Boiler Feed Water and be safe



It keeps the water level always at or near the center gauge. It does this automatically, constantly, and gives you immunity from loss or serious accident resulting from boiler explosion.

But that's not all. By maintaining the water at a fixed point, it increases steaming capacity to a point that represents an added efficiency in fuel, amounting to from 6 to 15%

There's nothing experimental about the Vigilant. For 20 years it has been a favorite feed water regulator in the largest mills and plants in America.

Sent on 60-Days' Free Trial. Write Us.

THE CHAPLIN-FULTON MFG. CO.
42 Penn Ave., Pittsburgh, Pa.

Also Manufacturers of the Fulton Pump Governor

ECONOMY

Renewable Cartridge

FUSES

are made in Canada and sanctioned for use by the Canadian Fire Underwriters' Association. Here and in the States, millions of Economy Fuses protect lives and property at an annual saving over old-style methods of eighty per cent. and more.

Your request for Catalog 24 and free samples of the desired types and capacities will bring prompt response.

ECONOMY FUSE & MFG. CO. OF CANADA, LIMITED
UNITY BUILDING - MONTREAL

Manufacturers in Canada of "S. & C." High Potential Fuses,—to 150,000 Volts

THE POWER HOUSE BUYERS' DIRECTORY

To Our Readers—Use this directory when seeking to buy power equipment or supplies. You will often get information that will save you money.

To Our Advertisers—Send in your name for insertion under the heading of the lines you make or sell.

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Lunkenheimer Co., Cincinnati, O.

Air Compressors and Receivers.
American Steam Pump Co., Battle Creek, Mich.
Belliss & Morcom, Birmingham, Eng.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.

Air Receivers.
MacKinnon, Holmes & Co., Sherbrooke, Que.

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Waterous Engine Works Co., Brantford, Ont.

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Waterous Engine Works Co., Brantford, Ont.

Belting, Stitched Cotton Duck.
Dominion Belting Co., Hamilton, Ont.

Belting, Leather.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Federal Engineering Co., Toronto, Ont.
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Graton & Knight Mfg. Co., Montreal.
D. K. McLaren, Ltd., Montreal.

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Can. H. W. Johns-Manville Co., Ltd., Toronto.
Canadian Consolidated Rubber Co., Montreal.
Jeffrey Manufacturing Co., Montreal.
Quaker City Rub. Co., Philadelphia.

Belting, Textile
Federal Engineering Co., Toronto, Ont.

Bins, Coal, Coke and Ore.
Jeffrey Manufacturing Co., Montreal.
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Waterous Engine Works Co., Brantford, Ont.

Blowers.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
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Boiler Arches.
Elk Fire Brick Co., Hamilton, Ont.

Boiler Compounds.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Dearborn Chemical Co. of Canada, Toronto.
C. C. Snowdon, Calgary.

Boiler Compound Feeders.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Can. Morehead Mfg. Co., Woodstock.

Boiler Feed Pumps.
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
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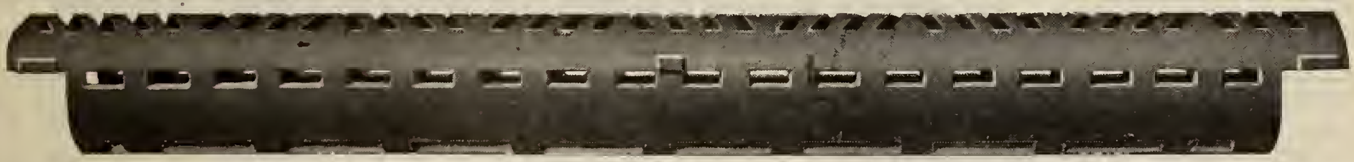

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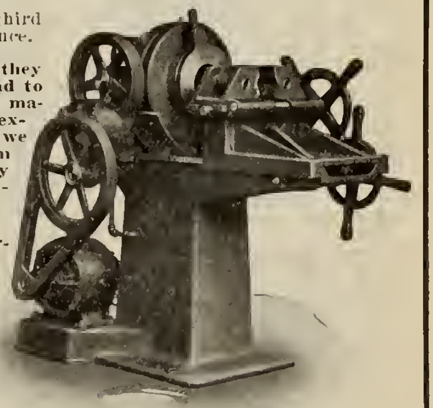

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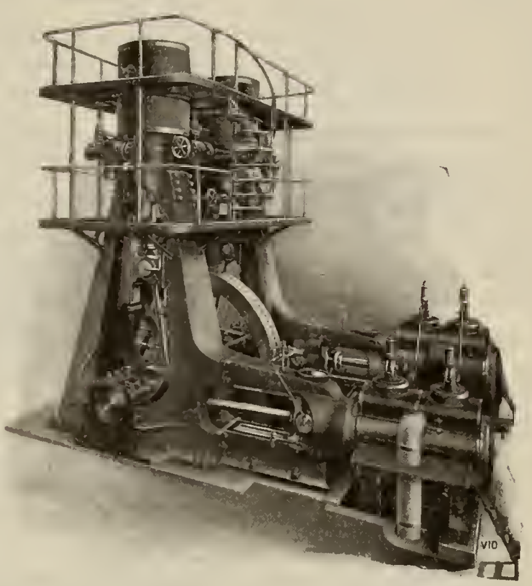

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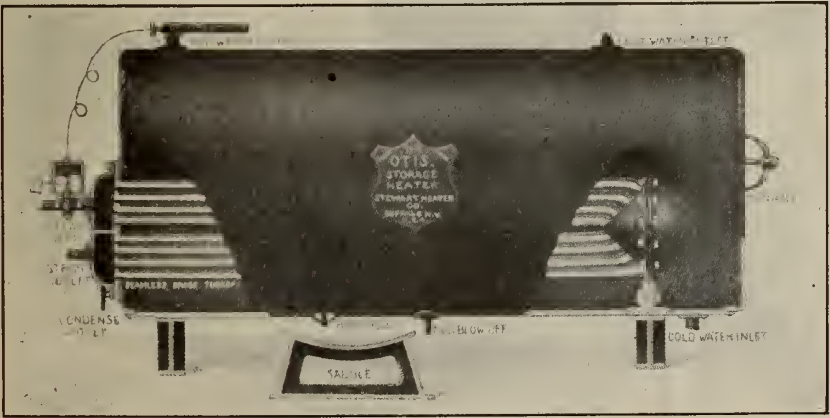

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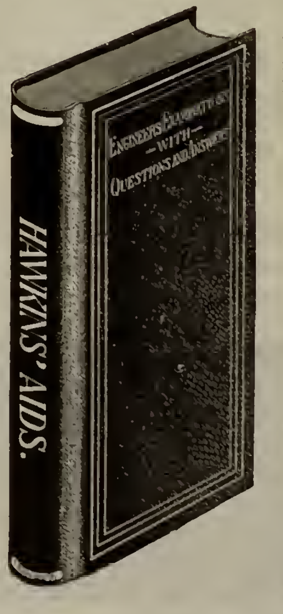

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Vol. IX. TORONTO, MARCH, 1916 No. 3

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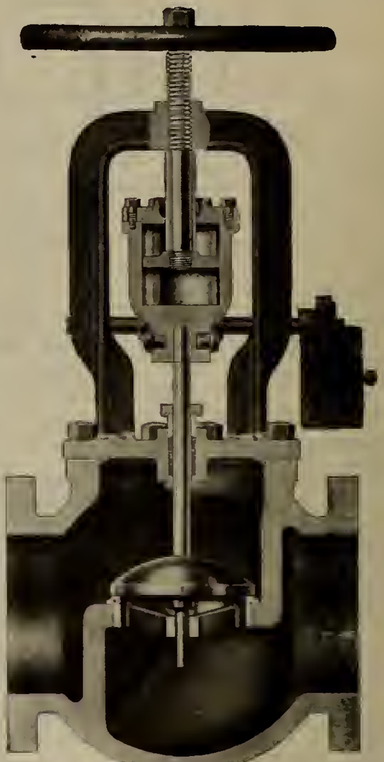

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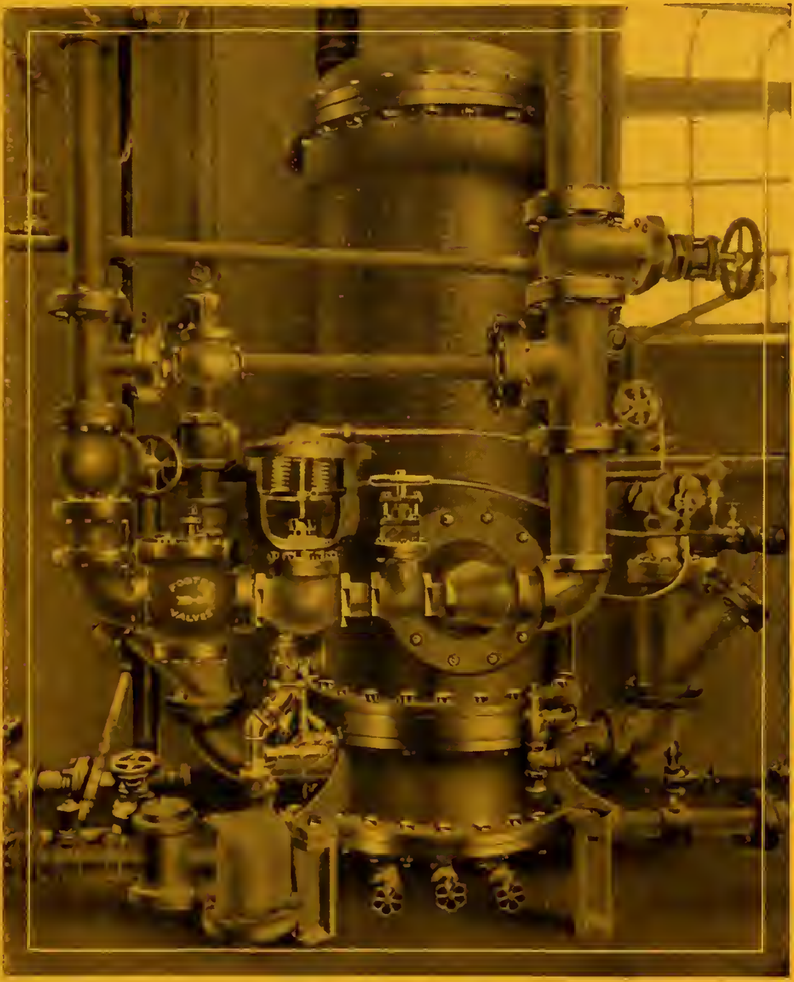

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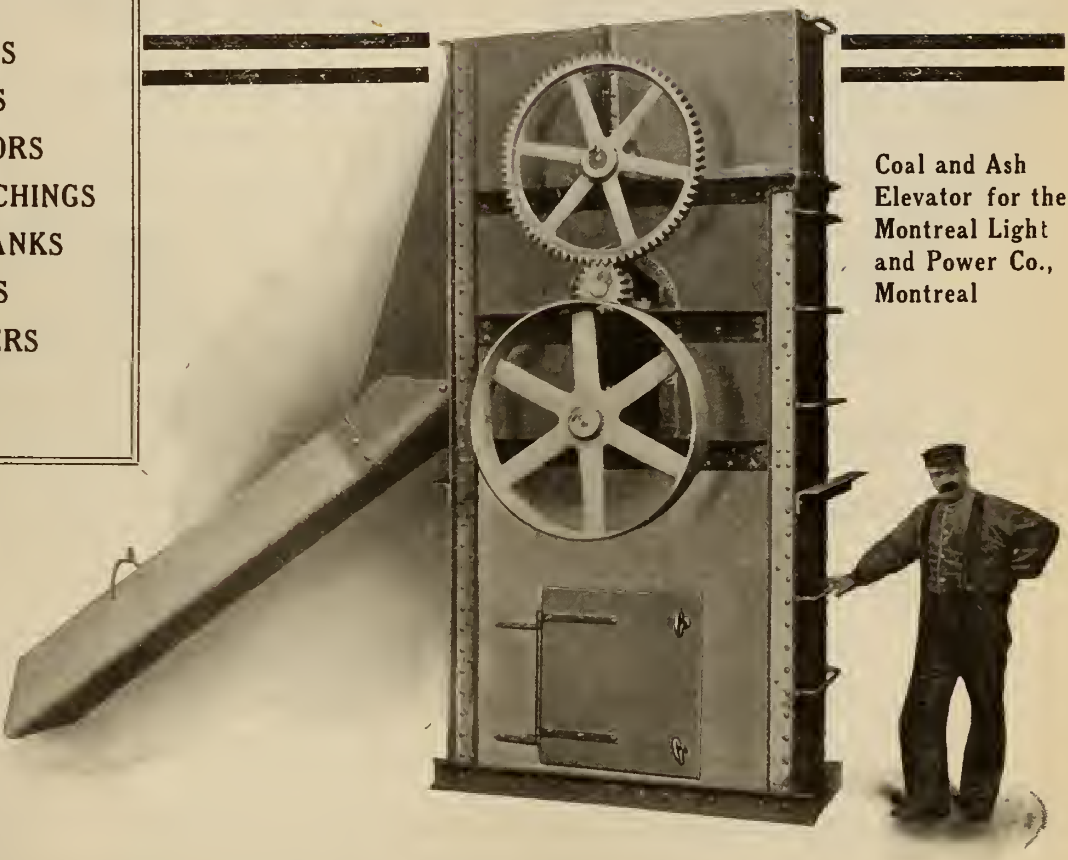

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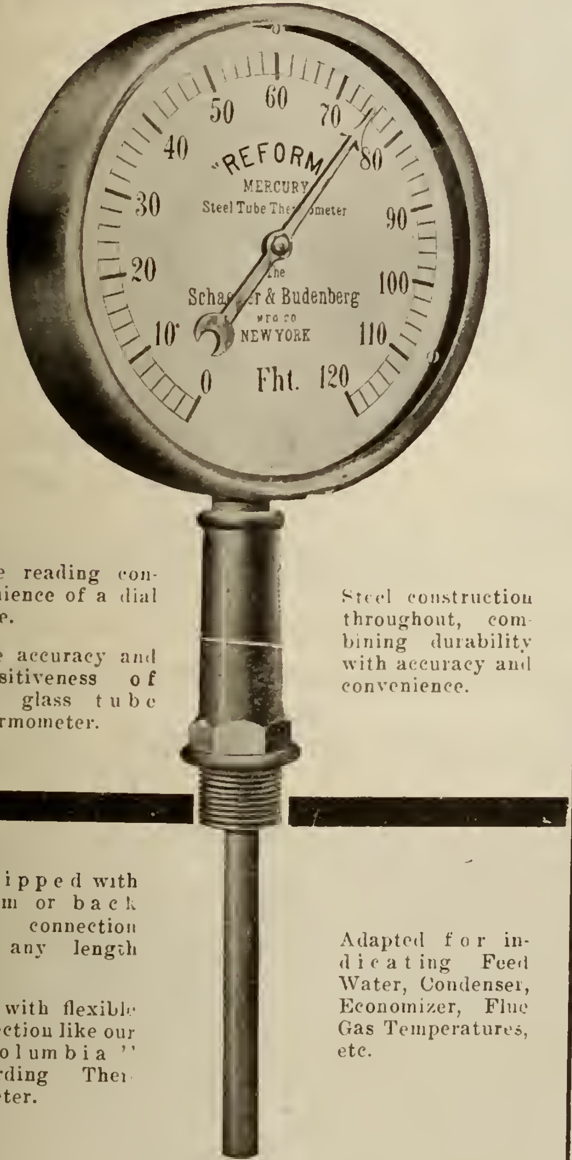

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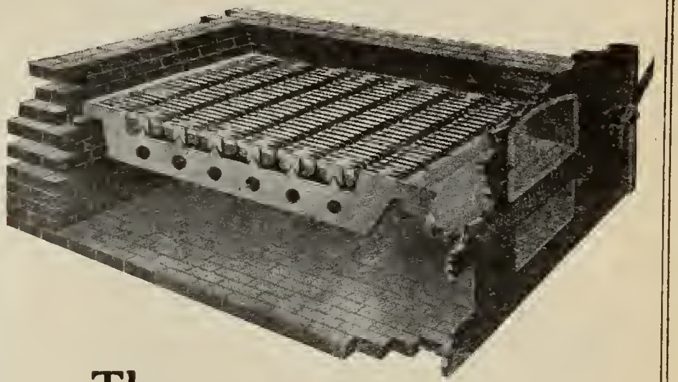

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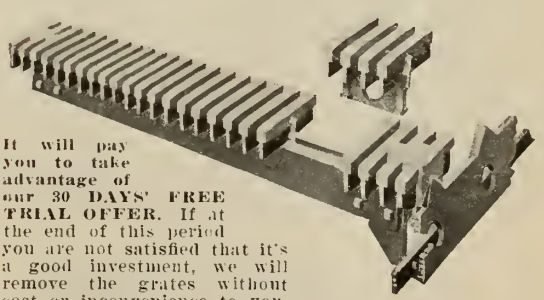

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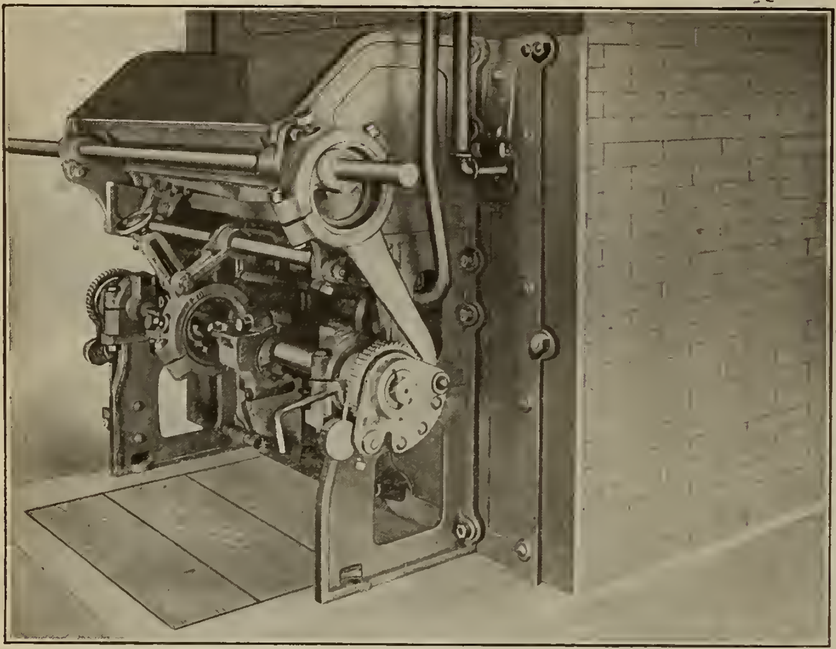

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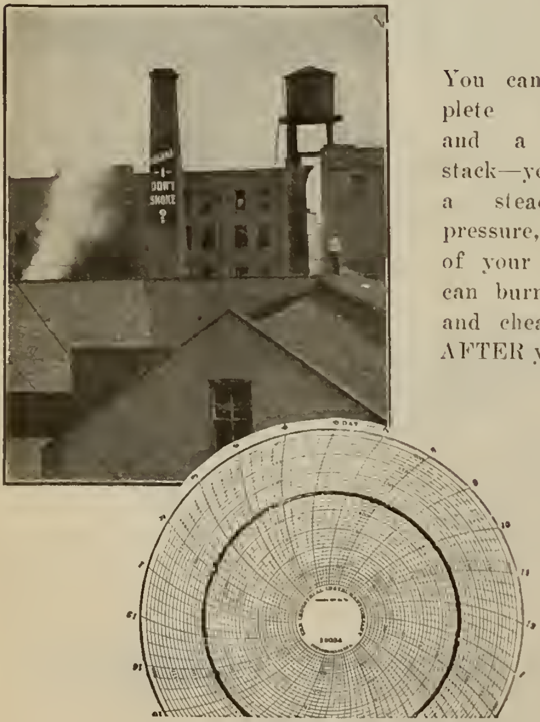

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2nd order, January, 1916	1 furnace,	155 H.P.
	5 furnaces,	655 H.P

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SOLVES THE PROBLEM OF OBTAINING PERFECT COMBUSTION OF THE FUEL YOU USE, OF GETTING BETTER FIRES AND GREATER ECONOMY IN FUEL CONSUMPTION.

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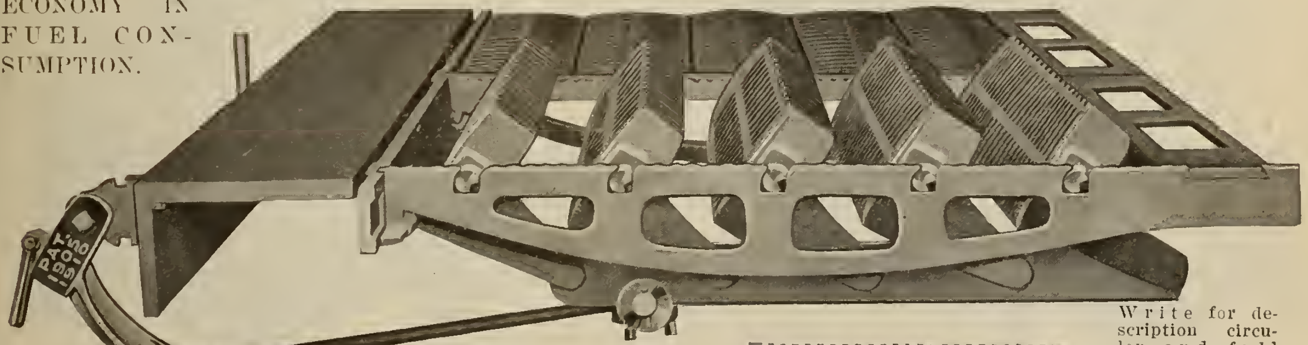

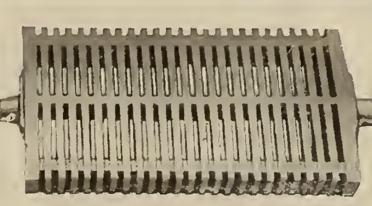

Write for description circular and full details of our **Free Trial Offer and Guarantee.** We have issued a new illustrated list of Cyclone Grate Bar parts. Copy of same mailed on request.

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Sole Manufacturers for Canada

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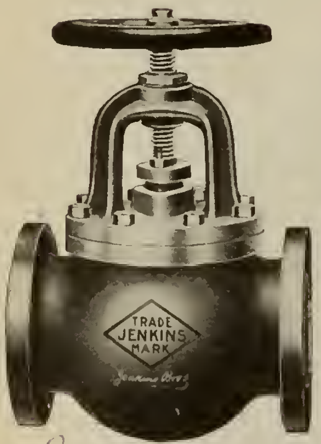

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FIG. 142
Outside View of a Jenkins Bros.' Standard Pattern Iron Body Globe Valve Flanged.

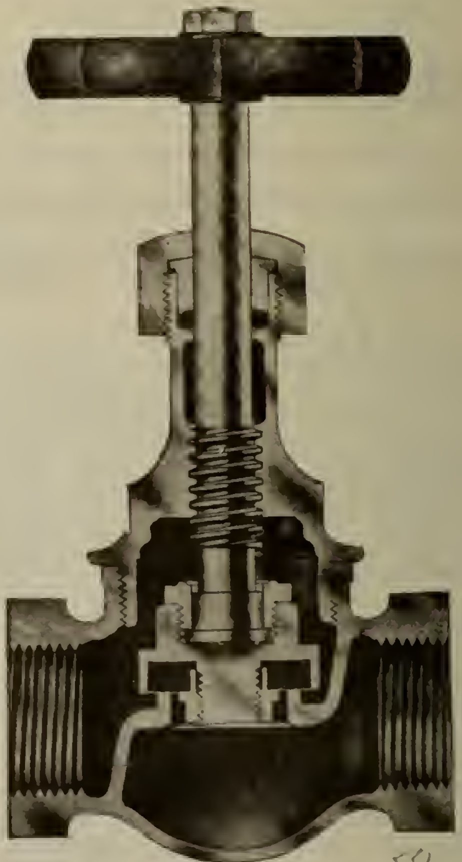

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FIG. 106
Interior View of a Jenkins Bros.' Standard Pattern Brass Globe Valve Screwed.

JENKINS BROS., LIMITED

103 St. Remi Street, Montreal

UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER

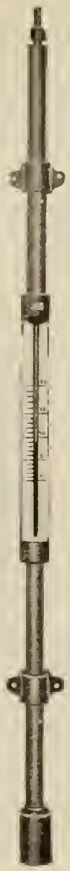
Record of CO_2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The Uehling CO_2 Recorder makes a complete 24 hr. record of your combustion efficiency and the CO_2 indicator at the Boiler Front holds the fireman responsible.

Get more Steam per pound of Coal and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.



CO_2 Indicator for Boiler Front

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

2008 Empire Building **New York City**

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

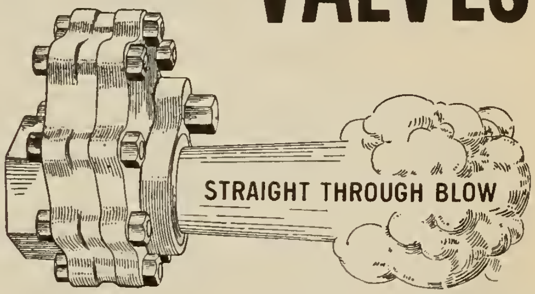
Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company

BOSTON, MASS.

CANADIAN AGENTS
H. L. PEILER & CO., MONTREAL and TORONTO

EVERLASTING Blow-Off VALVES



"EVERLASTING" Blow-Off Valves will immediately end your blow-off leaks or troubles.

No Packing.

No Stuffing Box.

Self-Grinding Seat.

Self-Cleaning.

—NOTHING TO GET OUT OF ORDER.

Over 220,000 in use

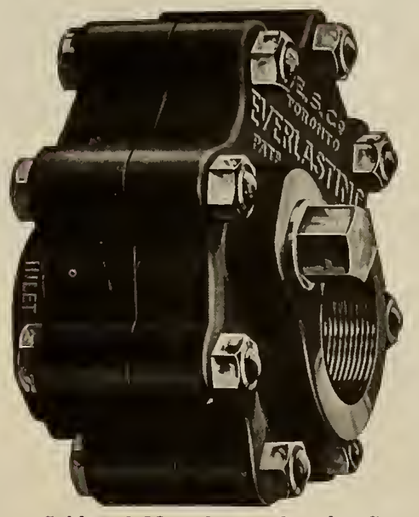
The *Everlasting Valve*—endorsed by leading Consulting Stationary and Marine Engineers.

Accepted by Boiler Inspection Insurance Companies.

Approved by all Provincial Governments requiring High Pressure Valves and Accessories to be registered and recorded. Provincial Record Numbers furnished on request.

OUR GUARANTEE—Satisfaction guaranteed or money refunded within one year.

Not guaranteed against galvanic action or corrosive acid.



Write for New Catalog No. V-15

Look for this ☛MARK

The word "EVERLASTING" is on every genuine "EVERLASTING" Blow-Off Valve — it's your safeguard against imitations.

Sold and Manufactured under Canadian Patents by

ENGINEERING SPECIALTIES COMPANY, Limited

1080 King St. West, Toronto

MONTREAL, QUE.
H. L. Peiler & Co.
VANCOUVER, B.C.
Taylor-Forbes Co., Ltd.
HAMILTON, ONT.
Dugald Turner, 110 Lister Chambers.

CALGARY, ALTA.
P. D. McLaren, Ltd.
WINNIPEG, MAN.
The A. R. Williams Mach. Co.
TRURO, N.S.
W. Davidson

Over half the oil you buy is wasted—

LOST in saturated floors, rags and waste

The use of the

Anderson Pressure Oil Filters

will eliminate this wastage

It is simply a matter of collecting it in drip pans, properly located beneath the engine or machinery. After passing through the Anderson Filter it can be used over again for lubricating purposes on the **finest bearings** until actually consumed.

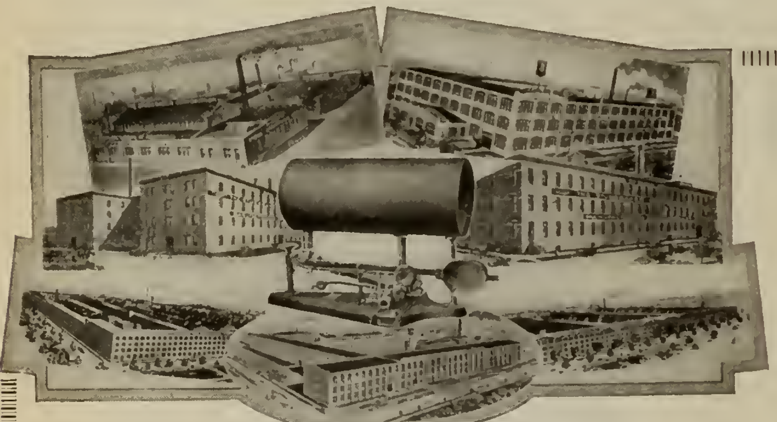
This new Anderson Process should not be confused with gravity or drip equipment. It is a filter press through which the oil is forced by direct pressure through either filter cloth or filter paper sufficiently heavy to extract the finest particles of grit.

The filtering medium is held firmly in position between rings and plates, and, being much heavier than can be employed with the gravity of straining process, IT GIVES FAR BETTER RESULTS.

The Anderson filter is the only one which treats the oil with the refiners process, and is therefore the only filter which can deliver the oil just as clean and pure as the new oil you purchase.

Our catalogue gives full details. Drop a line for it now.

The V. D. Anderson Co.
West 96th St., CLEVELAND, OHIO



Morehead
Back to Boiler
SYSTEM

Save Fuel
by Feeding
Your Boilers
DIRECT!

Did the STUDEBAKER CORPORATION Make the Same Mistake NINE Consecutive Times?

THE "MOREHEAD" System was first tried out by the Studebaker Corporation in 1909.

Since that time this monster concern has adopted this economy measure throughout seven great plants. The NINE repeat orders represent a total of 15 "Morehead" Traps. Could a more striking endorsement of the "Morehead" System be possible? The "Morehead" System is

Cutting Production Costs

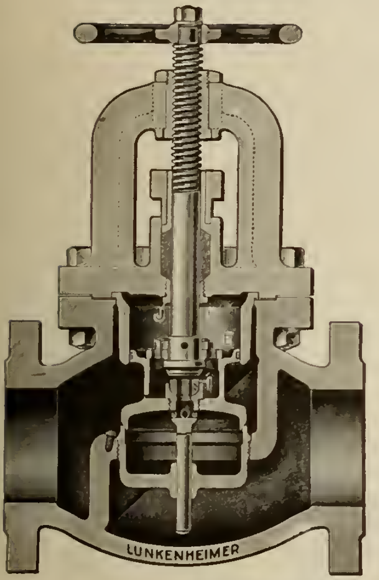
for thousands of managers from Maine to California. No matter how unusual or complex your problems may be—if you use steam, the "Morehead" engineers can suggest an installation which will pay for itself the first year of use.

Write for the Back-to-Boiler Book to-day.

Canadian Morehead Manufacturing Company
Woodstock Dept. "J" Ont.

382

LUNKENHEIMER
Balanced Throttle Valve
For Steam Power Units



Perfectly "balanced" by means of the *piston* and *internal by-pass,* to facilitate operation.

The by-pass can *also* be used for warming the unit before starting.

Disc and seat ring are provided with tubular extensions carrying the seating faces, forming a spring seat, which accommodates itself to any distortion that may be caused by expansion or strain and insures a tight valve at all times.

Only one handwheel is used to operate both the main valve and by-pass.

The materials used and the workmanship are "Lunkenheimer Quality."

Made in Globe and Angle Patterns, of Cast Iron, "Puddled" Semi-steel and Cast Steel, to suit various pressures and temperatures.

Write for *booklet No. 579* or *Catalog No. 50.*

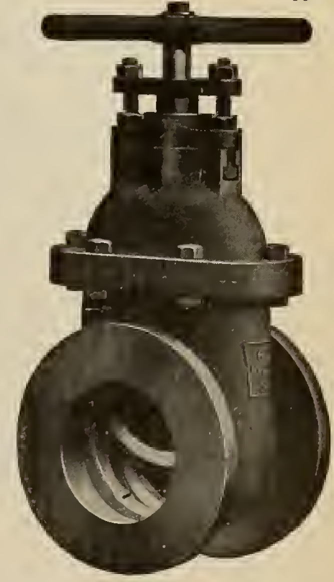
THE LUNKENHEIMER CO.
"QUALITY"
Largest Manufacturers of
High-Grade Engineering Specialties
in the World
CINCINNATI, O., U.S.A.

26-5-43 New York Chicago Boston London

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

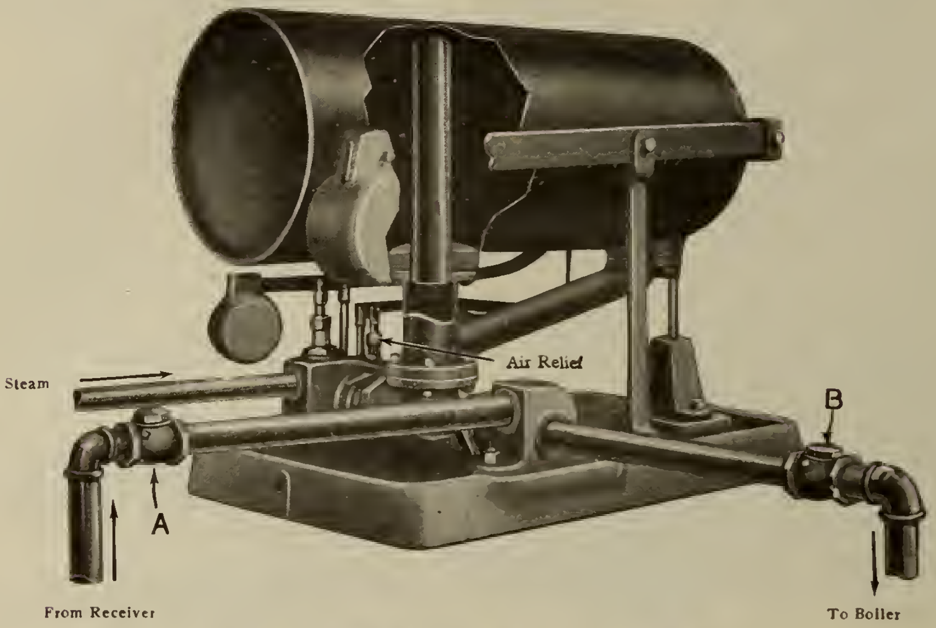
If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.



When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

Nothing Mysterious about a Detroit Trap
Every Working Part is on the Outside



"Detroit"

STEAM TRAPS

Some Facts You Should Know About Them

1. Nothing inside the tank to rust, corrode or give trouble—all working parts are on the outside and interchangeable.
2. Large water-handling capacities for space required. Will handle water at a higher temperature than a pump will lift.
3. Properly constructed — properly assembled and thoroughly tested before shipment.
4. Increase efficiency of steam coils or steam-heated machinery by keeping all lines free and clear of condensation.

These are only four of the reasons why "Detroit" Traps save money for the user. Trap catalogue No. 352 gives all information—capacities—sizes, etc. Write the home office or any sales office.

CANADIAN Sirocco COMPANY
LIMITED

WINDSOR, ONTARIO.

SALES OFFICES

S. S. Clarke,
605 2nd St.,
Calgary.

A. M. Nichol,
301 McGill Bldg.,
Montreal.

W. W. Hicks,
567 Banning St.,
Winnipeg.

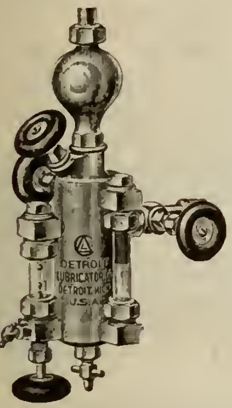
Canadian Steam Specialty Sales Co.,
526 Traders Bank Bldg.,
Toronto.
Phone Main 5118

Canadian Sirocco Company, Ltd.,
604 Credit Foncier Bldg.,
Vancouver.

Insist on "Genuine Detroit" Lubricators

Since 1867 the Detroit Lubricator Company has maintained the leadership in the manufacture of an efficient lubricating device for every purpose.

Over half the lubricators in the world are Detroits, and this demand for "Genuine Detroit" Lubricators is the demand for *quality*.



Naturally a product with the reputation of the Detroit has many imitators—some of the imitations being sold on the strength of looking like the Detroit and some as being "just as good as the Detroit."

For your protection we mark every package with the above trade-mark—look for it and see that you get the genuine.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

Largest manufacturers of lubricating devices in the world

Lubricating Line Shafting

so that there will be no waste or leakage, no need of oiling hangers (with its attendant danger to operatives) may be secured at the lowest possible cost with

Albany Grease

Many industrial plants all over the world are using Albany Grease with satisfaction. Why not you? We'll send a quantity of Albany Grease and a cup for you to try. No charge. Write now.

Your dealer sells Albany Grease ; if not, order direct

Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868

Treat the metal itself, if you would eliminate scale— and let the feed water alone

Try Perolin
MADE IN CANADA

Boiler Metal Treatment

—the method which is successfully solving the scale problem for over 25,000 progressive engineers

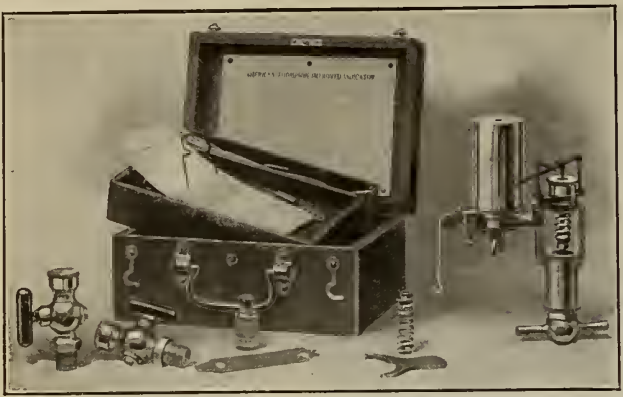
PEROLIN IS NOT A "BOILER COMPOUND" and has no chemical action either on the scale or on the water. It is purely a **Metal Treatment.** Perolin works through the cracks in the scale, which are caused by contraction and expansion, and working along the metal, loosens the scale **Mechanically,** so that it can be readily washed out.

When the old scale is removed, Perolin forms a preservative film over tubes and shell that prevents scale-forming substances from adhering to the metal. A little Perolin used daily ensures clean boilers.

You can demonstrate its effectiveness to your own satisfaction before you pay one cent, so write for particulars.

PEROLIN COMPANY OF CANADA, LIMITED
Office and Factory : 858 Dupont Street, TORONTO, ONTARIO
WESTERN AGENTS : Canadian Sarco Engineering Co., Limited, 1206 McArthur Bldg., Winnipeg, Man. Western Supply & Equipment Co., Limited, Calgary, Alta. Bayfield & Archibald, 334 Seymour St., Vancouver, B.C.

If any advertisement interests you, tear it out now and place with letters to be answered.



Real Indicator Value

The owner of an American-Thompson Improved Indicator who makes frequent regular tests of the engine under his charge soon learns from experience what REAL INDICATOR VALUE means. REAL PRIDE comes from such ownership and the knowledge gained in practice is always rewarded by increased confidence of the employer and INCREASED WAGES.

Ask any Engineer who owns one.

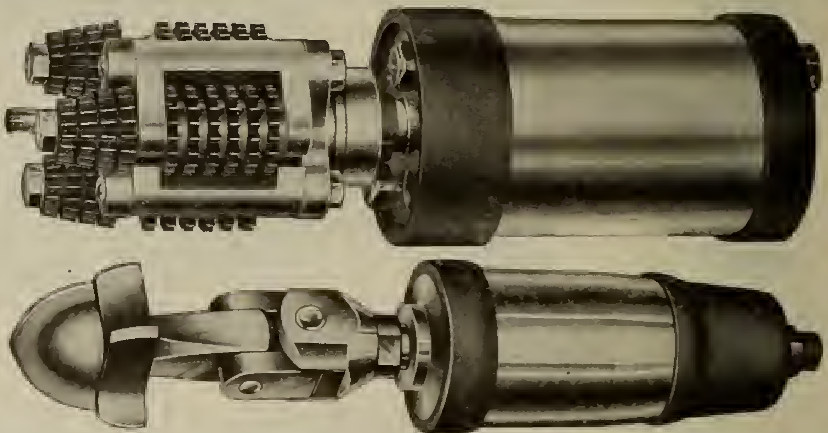
AMERICAN STEAM GAUGE & VALVE MFG. COMPANY

New York Chicago BOSTON Atlanta Pittsburg

ROTO TUBE CLEANERS

Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.
The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.



THE ROTO COMPANY
Write for Catalog HARTFORD, CONN.

What You GET—

Dean

Don't overlook the question "What Do I Get?" when you buy a boiler tube cleaner—because it's what the cleaner will do that makes all the difference between efficient, successful results and rank failure.

When you specify the DEAN CLEANER, you get a tube cleaner that operates on the one correct principle —**VIBRATION.** Boring gets out some scale—after a fashion; pounding gets out some, too—after a fashion; but vibration (the greatest, most powerful energy known to science) gets it ALL out and leaves your tubes so clean and so bare that they look like new. This means that your boilers will steam better, that burned-out tubes are impossible and that operating costs will decrease.

Send now—while you're thinking about it—for "Scale Removal Made Easy" (it's free) and ask for details of FREE TRIAL PLAN. You may need the Dean badly—but don't know it. It's worth finding out.

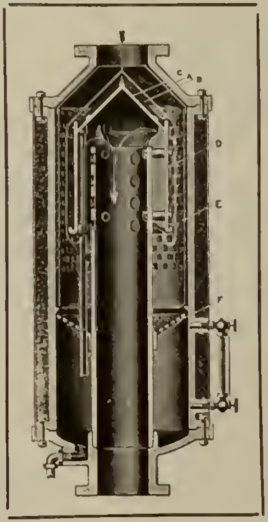
The William B. Pierce Co.

153 Ellicott St.
Buffalo, N.Y.

201-2 Coristine Bldg.
Montreal, Quebec.

Winnipeg Representative: W. W. Hicks, 567 Banning Street

A Unique Feature Of Sweet's Separators



When a drop of water is *once* removed from the steam current by Sweet's Separator, it is *completely* removed, the Separator being so designed that the water never comes into contact with the steam current again.

This is a most important feature and one possessed by no other separator on the market.

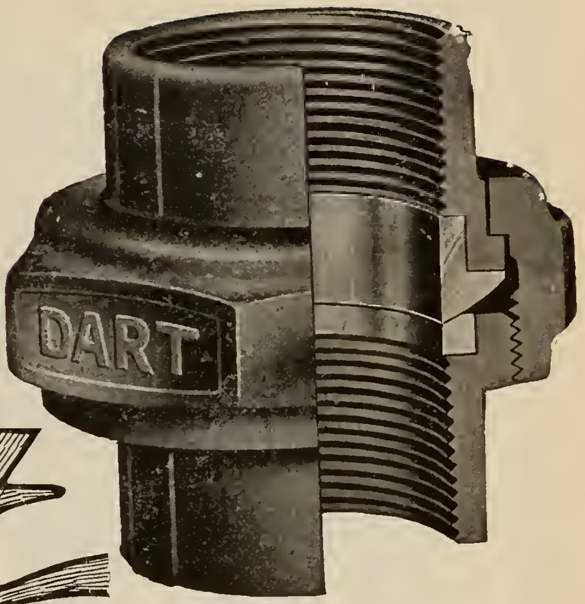
It also gives positive separation under all conditions.

Over 7,000 in use at the present time.

Let us send you *full* details. *Write!*

DIRECT SEPARATOR COMPANY
820 South Geddes Street SYRACUSE, N. Y.

General Sales Agents:
Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Vancouver, Victoria.



Dart
UNIONS

Never Leak

Bronze meets Bronze—there is no possibility of rust or corrosion—nothing to decay and cause leakage.

The efficiency of the Dart is made double-sure by the heavy iron parts which will not stretch or pull apart.

The Dart saves time and bother because it is easily and quickly connected, whether pipes are in or out of alignment.

POSITIVELY GUARANTEED

Sold by all Jobbers

Manufactured by

Dart Union Co., Ltd., Toronto

Bronze to Bronze at the Joint

Don't Take Chances
Pack the Globe Valves
with
TRADE MARK
"PALMETTO" TWIST PACKING

It's an Insurance Against Trouble

"Palmetto" gives long service because the lubricant in each single strand keeps it soft and pliable.

Any Size Valve
Packed from
One Spool

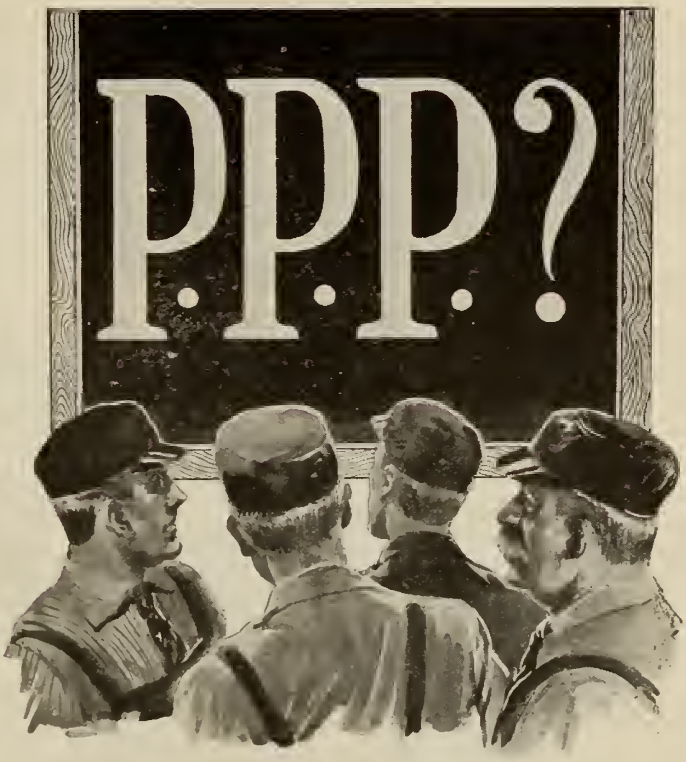
To prove what a friend "Palmetto" Twist can be to you, let us send you a free sample spool.

GREENE, TWEED & CO.
SOLE MANUFACTURERS
109 Duane Street New York
Canadian Distributing Agents:
The CANADIAN FAIRBANKS-MORSE CO., LIMITED
Montreal, Ottawa, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Victoria, Vancouver

What's the Meaning?

Tens of thousands of engineers in the United States, Canada, Central and South America and throughout the world are using P.P.P. Likely, you do, too, but do you know the meaning of the three letters that stand for this trouble-saving and money-saving rod packing?

Fill out the coupon and give your answer to this question. In return we will send you the Engineers' License Book, without cost to you.



DANIEL'S ROD PACKING **P.P.P.** **FOR STEAM, AIR, WATER, AMMONIA**

Reg. U. S. Pat. Off.

P.P.P., to its users, means savings in power cost, freedom from trouble and no night or Sunday work repacking rods. For actual records show that P.P.P. can save up to $500.00 yearly, on power cost, and that it lasts for months—in many cases, one to two years. If you send an answer or not, see our May ad.—it will give the answer to the meaning of "P.P.P.?"

What About Our March Ad?

What did you notice about the fly-wheel of the Ammonia Compressor shown in our March ad.? Write your answer on a slip of paper, with your name and address, then mail it to us. We will send you something you will be glad to get.

License Examination Book, Free

Fill out and mail this coupon. We will send you our Blue Book of Questions and Answers to Engineers' License Examinations absolutely FREE.

Your name.......................................

Address.......................................

Capacity of Ice Machine.......................................

Employed by.......................................

Address.......................................

Horsepower of engine.......................................

Brand of Rod Packing Used.......................................

Form of Packing Used—Coil...Spiral...Ring...
(Check X)

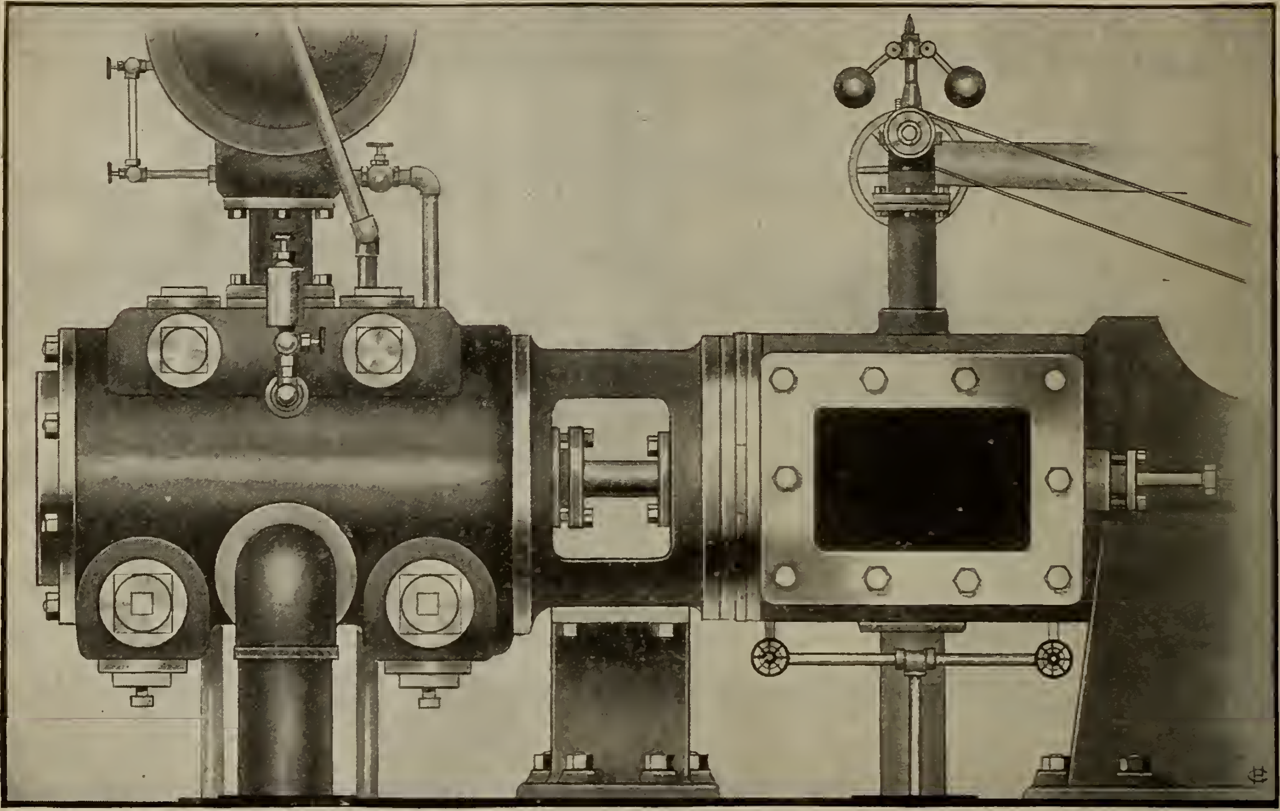
What does P. P. P. mean?.......................................

.... 24-D

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS

629 MARKET STREET, PHILADELPHIA, PA., U.S.A.



GARLOCK
Air Compressor Packings

Are designed to withstand the extremely severe conditions under which air compressors usually are operated. Style No. 420 is composed of high pressure and compressor combination rings. The cushion center of the latter is covered by long fibre woven asbestos lubricated throughout with the celebrated Garlock compound. This packing does not harden in service, but retains its elasticity under the high temperatures and pressures met with in this class of work.

Garlock No. 950 Gaskets are unsurpassed for service on air compressor cylinders and flanged joints.

The Garlock Packing Company, Hamilton, Ont.

BRANCHES:
Montreal, Quebec - - - 342 St. James St.
Toronto, Ontario - - 404 Continental Life Building.
Winnipeg, Manitoba - - - Galt Building.

Johns-Manville

JOHNS-MANVILLE SERVICE

COVERS THE CONTINENT

Serves More People in More Ways than Any Institution of its kind in the world.

BEING able to watch the bigger things in the plant makes the engineer an important man. By regulating the routine work, he has time to think out the important jobs that the unmethodical fellow "never has time for."

J-M Power Plant supplies, through standardization, are a convenience to the purchaser.

By the quality itself they are trouble-savers and because they are sold on a no-risk-to-you basis, they are a time-saving economy.

The Canadian H. W. Johns-Manville Co., Limited
Toronto Montreal
Winnipeg Vancouver

Here's a "tough" proposition in Sheet Packing—J-M Permanite

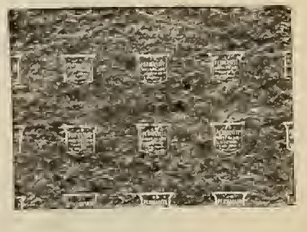
It's good for steam—has great pliability, heat-resisting and resiliency qualities.

It's good for ammonia and acidulated solutions.

There is nothing in Permanite construction that is affected by any of those things that are ruinous to other packings.

It is the only successful result of combining the features and advantages of rubber and asbestos into one single packing.

It's tough—will not squeeze out, burn out or stick to flanges. It is a sheet for **all** conditions—which means that you need not carry a large stock of different packings; and it is very light in weight. Why not enlist in the army of Permanite Users?



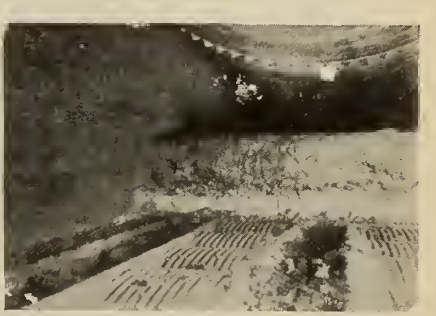
J-M Permanite

J-M Fire-Brick Treatment avoids the useless labor of frequent boiler resetting

The principal cause for frequent resetting is the concentration of heat on the exposed surface of fire-brick and where the edges meet. The constant play of the flames soon spawls or else fuses the brick, opens up joints and eats the life out of the whole expensive setting.

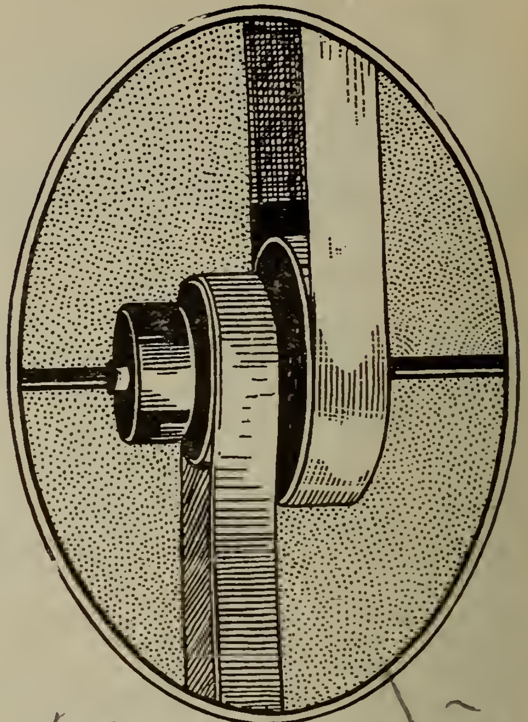
J-M No. 31 High Temperature Cement is used as a mortar between the fire-brick courses and seals them into a solid vitrified wall of cement and brick that will resist any change of temperature to which your boiler may be subjected. It vitrifies at a low furnace temperature and maintains this condition up to 3187° F., its fusing point, which is greatly in excess of your furnace requirements.

When the new setting is made, **No. 32 High Temperature Cement** should be painted over the entire face, filling up all cracks and pores in the brick face, preventing cracking, spawling, gas or air leaks under the most severe furnace heat. Write any branch for Booklet.



Boiler Furnace Wall set with J-M No. 31 H. T. Cement in boiler room of Christian Science Pub. Co., Boston. In continual use under stoker conditions for nearly a year, and still good for an indefinite period.

Service and Responsibility



Mr. Chief Engineer---

When you hire a man you see to it that he has a good record and recommendation.

Why not exercise as much care in employing belting?

You will be keeping yourself on the safe side and you'll eventually be money in pocket by making a thorough investigation of the service of

GENUINE OAK
REGISTERED TRADE MARK

This trade-mark guarantee is on every piece of D. K. McLaren's leather belting. Look for it.

D. K. McLaren's
Genuine British Oak-Tanned
Leather Belting

Now the easiest way to do this is to ask us to give you names of users right in your town, and then call and see the belt in operation and have a talk with the other chief about it. You can judge by what he says whether it would be a good investment or not.

There's no better time than now to do this.

Drop us a card while it's fresh on your mind.

MANY OF CANADA'S LARGEST POWER PLANTS ARE OUR STEADY CUSTOMERS—there's a reason which only the user appreciates.

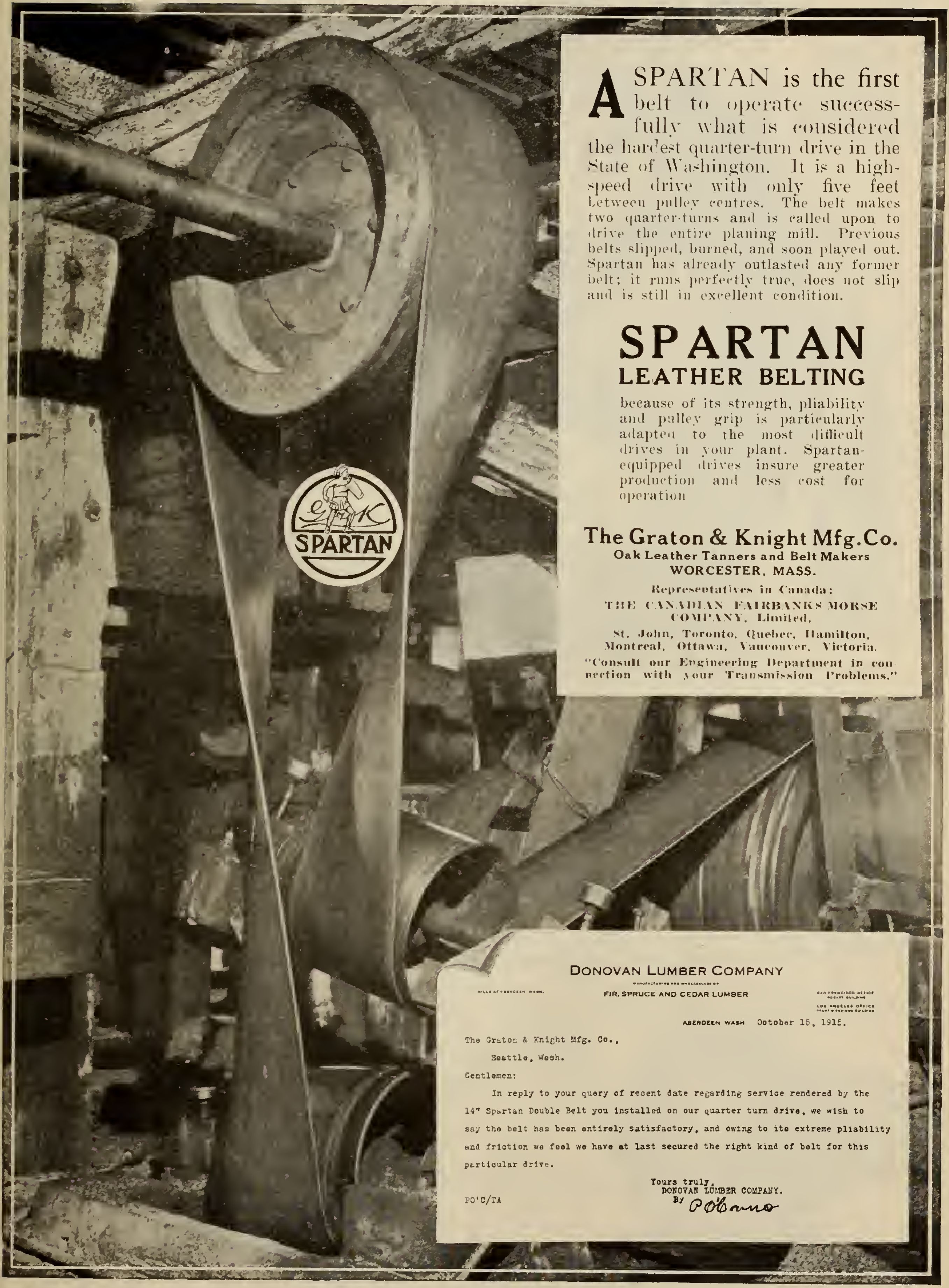
D·K·McLAREN
LIMITED

Head Office and Factory:
351 St. James St., Montreal, P.Q.

TORONTO, ONT. 200 King St. West
ST. JOHN, N.B. 64 Prince William St.
VANCOUVER, B.C. 847 Beatty St.

ENGINEERS SUPPLY CO., 123 Bannatyne Ave. E., Winnipeg, Man.

1 Cut received
Sept 1 - 1916



A SPARTAN is the first belt to operate successfully what is considered the hardest quarter-turn drive in the State of Washington. It is a high-speed drive with only five feet between pulley centres. The belt makes two quarter-turns and is called upon to drive the entire planing mill. Previous belts slipped, burned, and soon played out. Spartan has already outlasted any former belt; it runs perfectly true, does not slip and is still in excellent condition.

SPARTAN
LEATHER BELTING

because of its strength, pliability and pulley grip is particularly adapted to the most difficult drives in your plant. Spartan-equipped drives insure greater production and less cost for operation

The Graton & Knight Mfg. Co.
Oak Leather Tanners and Belt Makers
WORCESTER, MASS.

Representatives in Canada:
THE CANADIAN FAIRBANKS-MORSE COMPANY, Limited,
St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.

"Consult our Engineering Department in connection with your Transmission Problems."

DONOVAN LUMBER COMPANY
MANUFACTURERS AND WHOLESALERS OF
MILLS AT ABERDEEN WASH.
FIR, SPRUCE AND CEDAR LUMBER
SAN FRANCISCO OFFICE
LOS ANGELES OFFICE

ABERDEEN WASH October 15, 1915.

The Graton & Knight Mfg. Co.,
Seattle, Wash.

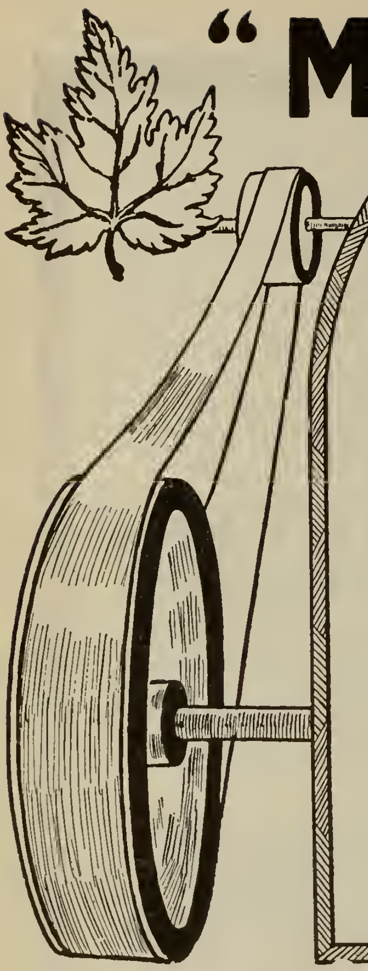
Gentlemen:

In reply to your query of recent date regarding service rendered by the 14" Spartan Double Belt you installed on our quarter turn drive, we wish to say the belt has been entirely satisfactory, and owing to its extreme pliability and friction we feel we have at last secured the right kind of belt for this particular drive.

Yours truly,
DONOVAN LUMBER COMPANY.
By

PO'C/TA

If any advertisement interests you, tear it out now and place with letters to be answered.



"MAPLE LEAF"

Stitched Cotton Duck

Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.
A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC
METALLIC PACKING
FOR STEAM, WATER, AIR, GAS, ETC.

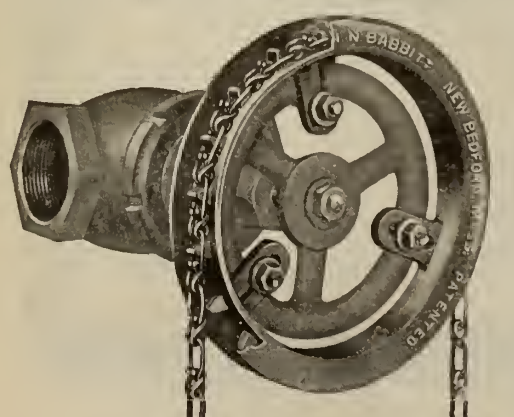
LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.

MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless

Any Quantity sent
on APPROVAL



While You're Looking for a Ladder

that "isn't there," you can open or close a dozen of those valves that are in hard-to-get-at places (and without any risk of being thrown on your head), if you

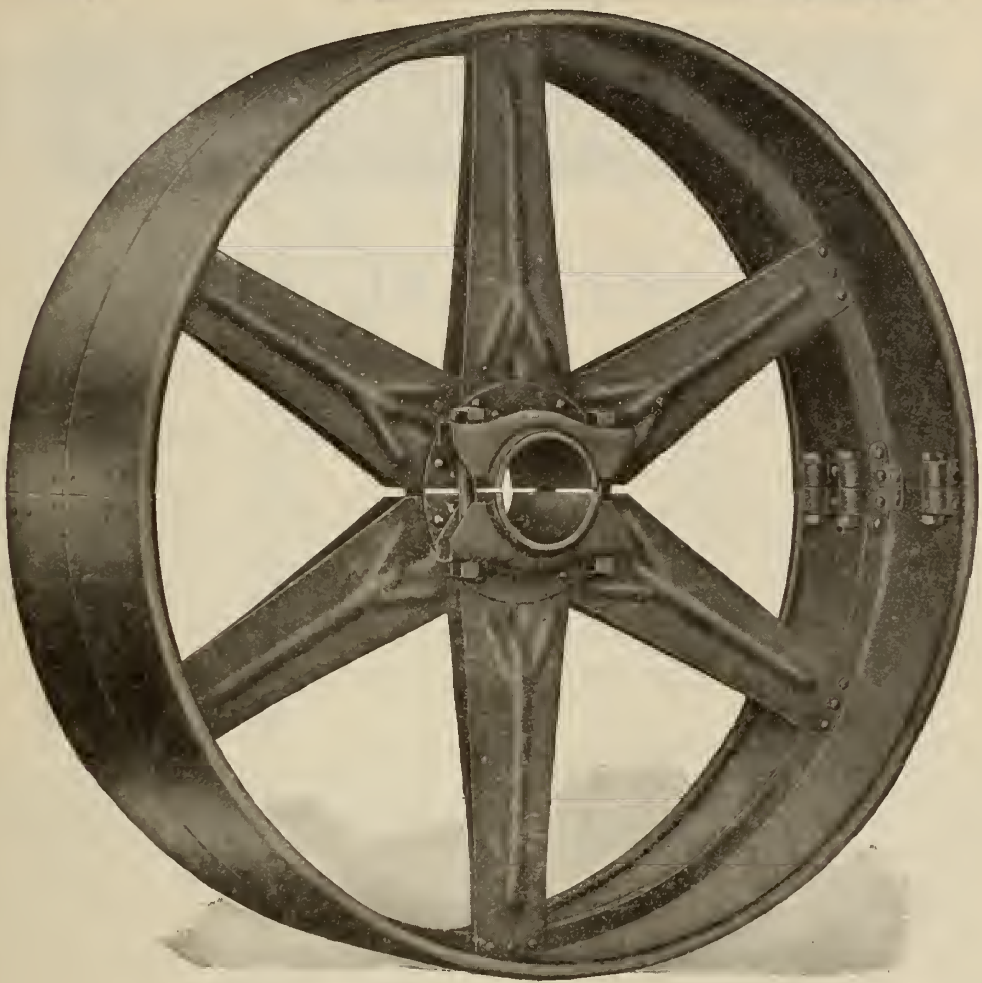
Use The

Babbitt Adjustable Sprocket Rim

Goes right on your present valve wheel, without a bit of bother. No chance for the chain to slip. The price is low. You'll say so, too. Ask your dealer.

Write for Illustrated Folder It's a decidedly interesting proposition.

Babbitt Steam Specialty Co., 59 So. Water St., **New Bedford, Mass.**



(PATENTED)

IN December, 1915, tests were made by Wm. W. Crosby, of H. M. Haven & Wm. M. Crosby, of Boston, to determine the slip between a belt and pulley faces when the belts were transmitting different horse powers.

Haven and Crosby's report concludes with the following comment:

> "These tests show that steel pulleys have much less belt slip than cast iron pulleys, and a little less, on the whole, than wood pulleys. They also show that the *American Pulley Company's steel pulleys have less belt slip* than either of the other two steel pulleys under the conditions as noted and observed in the tests."

A summary of Haven and Crosby's report, and the full report with all details are in print, and either, as requested, will be sent on application.

Remember that the pulleys of The American Pulley Co. have arms which cut the air instead of beating it. This feature will save enough power to pay a handsome return on the cost of the pulley every year.

Interchangeable bushings
Listed sizes 3" to 120" diameter.
All pulleys guaranteed.

The American Pulley Company

Williams & Wilson, Limited, Montreal
The A. R. Williams Machinery Co., Limited, St. John, N.B.,
Toronto, Winnipeg, Vancouver

FOR SEED OIL MILLS

ZEBULON COTTON OIL COMPANY.

Zebulon, N.C., April 3, 1915.

Gentlemen :—

I will say in regard to Magnolia Metal that it gives me far better satisfaction than any metal that I have ever used. I gave it a fair and impartial trial with other metals some higher priced than Magnolia—and I can say that Magnolia held up better than any that I used under the same load and same lubricant. It seems to have a better base and does not heat or scar the journal as other metals did, and also did not pull out or run. I have been using metals for 25 years and am competent to judge, and Magnolia is the best metal that I have ever used.

Very truly,

R. W. GADD, Supt.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c. post paid.

Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

OFFICE AND FACTORY:
225 St. Ambroise St. MONTREAL

Sliptivity Steam Cylinder
Sliptivity Steam Engine
Automobile Cylinder

OILS

These highly efficient lubricants go a long way and will greatly add to the life of your machinery.

They are a triple combination that's hard to equal. A trial will convince you of this fact and create a desire for more.

USED OVER THE ENTIRE WORLD.

Our prices are very reasonable for that of good quality.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating **and** Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384, P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 877.

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

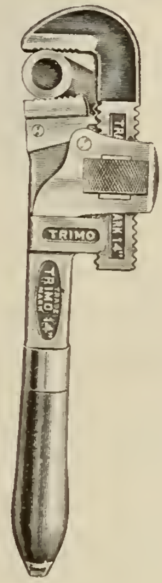
These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards



Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

STARRETT TOOLS
TRADE MARK REG. U.S. PAT. OFF.

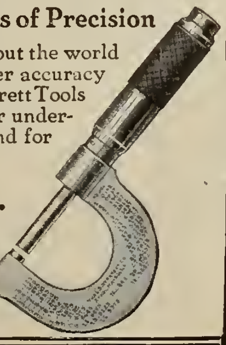
What Tools Do You Use?

A GOOD workman can always do good work but he does his best work with good tools. The conscientious man always wants to do his best work. The inference is obvious. Good men always have good tools.

Starrett Tools

and Instruments of Precision

are recognized throughout the world as standard. Wherever accuracy counts you will find Starrett Tools widely used. To better understand the whole line send for free catalog No. 20-CD



The L. S. Starrett Co.

"The World's Greatest Tool Makers"

Athol, Mass.

New York London Chicago

NO MORE TIGHT BELTS
CLING-SURFACE
CLING-SURFACE
CLING-SURFACE
THE DAYS OF TIGHT BELTS ARE OVER
CLING-SURFACE CO. BUFFALO, N.Y., U.S.A.

CLING - SURFACE does the trick every time

Read these three letters, order a trial tin, give a fair trial and YOU will be just as enthusiastic.

"How am I coming on with Cling-Surface? I am not coming on—I AM on. No slip. No squeak. Running like a top. What more should I want?"

And in the same mail, another: *"Good belt service from Cling-Surface is the best paying investment in our place."*

And still another: *"Cling-Surface caused a 5-in. and a 6-in. belt to take to the center of the pulleys, when before they drove to one side." (Names on application).*

A trial of Cling-Surface at a few cents cost will bring you *immediate, marked* and *lasting* belt improvements. Send at least for literature.

We quote f.o.b. Toronto.

Cling-Surface the true preserver for belts

Cling-Surface Co

1057 Niagara Street
Buffalo NY

I am interested in Cling-Surface and your trial order proposition.

Name ....Position..............

Firm ....

Street ....

City ....Province..............

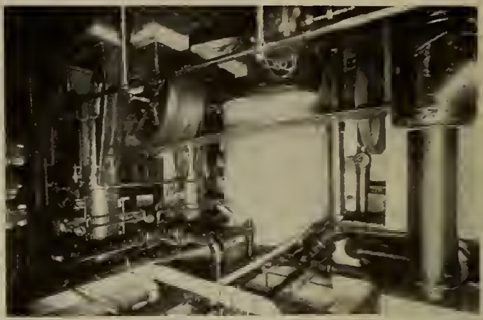
94

If any advertisement interests you, tear it out now and place with letters to be answered.

Can You Afford to Leave Your Cold Pipes Bare?

No, not unless your refrigeration costs you nothing. Even a 1½-inch line, 200 feet long, carrying brine at 15° F., with the surrounding air at 90° will lose $206.22 worth of refrigeration per year, figuring refrigeration at the low cost of 50 cents per ton.

If this same line is insulated with



Engine room of Davenport Hotel, Spokane, Wash., showing part of the 3,000 feet of Nonpareil Cork Covering and Fitting Covers installed on brine and ammonia lines.

Nonpareil Cork Covering

for Brine and Ammonia Lines

at a cost of about $160.00, the loss will amount to only $37.41 per year. That means a direct saving of $168.81 per annum, or in other words, a return of 105% on the investment.

Best of all, Nonpareil Cork Covering does not require expensive repairs and constant replacement. It is durable in service because cork is cellular in structure—not fibrous, and hence, will not suck in moisture from the atmosphere by capillary attraction. As an additional safeguard, however, Nonpareil Covering is coated inside and out with mineral rubber, making it almost impossible for moisture to get in.

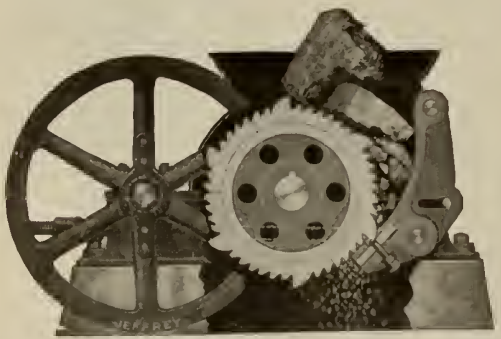
Full information regarding Nonpareil Cork Covering is given in a new 64-page book, which, together with a sample of the covering, will be sent free on request.

Write for them to-day.

Armstrong Cork & Insulation Co., Limited 504 McGill Bldg. Montreal, Que.

Also manufacturers of Nonpareil Corkboard for all cold storage rooms.

Power Plants equipped with this machine are prepared to meet any emergency in the scarcity of fine coal.



The Jeffrey SINGLE ROLL Crusher

will reduce your Run-of-Mine Coal to any sized product from ¾" to 6", and in a Single Operation.

Built in four sizes—with capacities from 20 to 200 tons per hour.

Bulletin No. 141-4 has full information as to the Design, Construction and Capabilities of this Crusher.

The Jeffrey Mfg., Company,
Canadian Branch & Warerooms, MONTREAL.

Is your boiler burning money?

In these hard times you can find a better use for it than that.

A "Bennis" Stoker in the boiler house will put things right.

It turns rubbish into steam — waste into gold.

The Balance Sheet will look better: the output will be greater, the working costs lower, and there will be less depreciation of your plant.

Illustrated Catalogs on request.

The G. H. TOD CO.

10 Croft Street
TORONTO

601 Union Bank Bldg.
WINNIPEG

THE PERFECT SPECIMEN

WITH a predetermined definite knowledge of what it must be, and with his mind's eye keyed to instantaneous response, the professor of forestry will pass by thousands of trees (each seemingly perfect to you and to me) with never a second look; thousands more will be eliminated because of some deformity unnoticed by others, yet the one tree he seeks—a perfect specimen—will stop him, hold his attention and be accepted.

It is much the same with power transmissions.

Leather belts and gearing have service, locations and applications in which they still excel all other forms of transmission, but one cannot displace the other without radical changes in general layout and design.

Gearing requires microscopic adjustment on very short centers, requires much lubrication, is noisy, and loses its efficiency as the teeth wear.

Belting cannot be satisfactorily used on very short centers, is not positive and loses much power.

The "silent chain" is the natural outcome of a search for a transmitter to combine the advantages of both belting and gearing, but without their disadvantages. It is positive, like gearing, requires less lubrication, is quiet running at high or low speed, and holds its higher efficiency throughout its entire life.

The "silent chain" is flexible, like belting, yet cannot slip over the wheels and lose power; it can be used on very short centers; and it is from 10 per cent. to 20 per cent. more efficient than belting.

The MORSE Silent Chain, with its exclusive "rocker-joint" construction, which reduces wear to a minimum, comes nearer mechanical perfection than any other type, proven by its popularity with the mechanical profession (almost 1,500,000 horse-power being now in service), and by the service records of thousands of drives operating under different conditions.

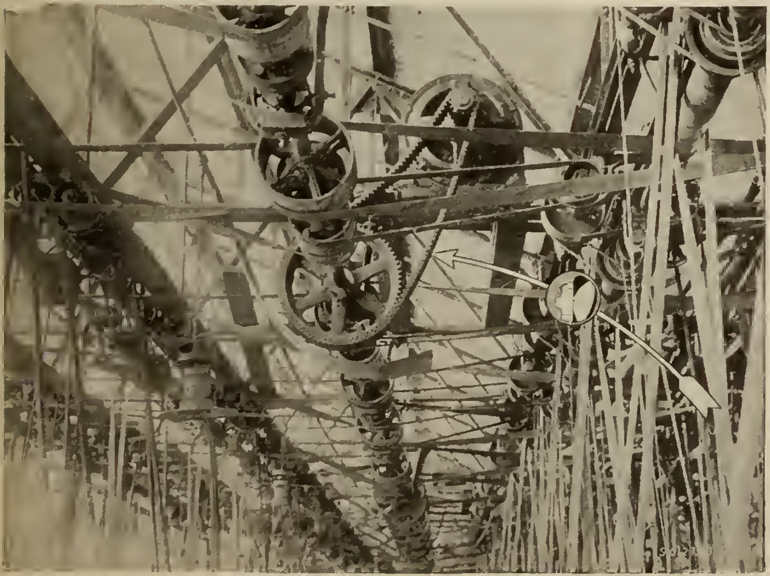
Practically every known power-using industry now has MORSE Silent Chain Drives in one service or another.

Whether your requirements are for a baby ¼ hp. drive, a 50 hp. line-shaft drive (as illustrated), or for a giant 5000 hp. drive, you can safely place your reliance in a MORSE Chain, for they alone are built upon the valuable "Rocker-Joint" principle.

Send us a letter or the coupon below, stating just what you are interested in and we will mail free literature, showing what we have done for others along the same lines. Do not hesitate. We are always glad to furnish information free.

Morse Chain Co., General Offices and Works; Ithaca, N.Y.

NEW YORK..........50 Church Street
BOSTON................141 Milk Street
CHICAGO..Merchants L. & T. Building
PITTSBURGH..Westinghouse Building
CLEVELAND...421 Engineers Building
DETROIT.........1003 Woodward Ave.
SAN FRANCISCO.Monadnock Building
ST. LOUIS...Morse Engineering Co., Chemical Building
KANSAS CITY.Morse Engineering Co., R. A. Long Bldg.
MINNEAPOLIS..Strong-Scott Mfg. Co., 413 Third St., S.
ATLANTA....Earl F. Scott, M.E., 702 Candler Building
GREENSBORO, N.C...G. W. Pritchett, 805 Ashboro St.
Licensees for Europe: The Westinghouse Brake Co., Ltd., 32 York Road, King's Cross, London, N.



Morse Chain Co.

Gentlemen: Please send me your latest publications on "A CHAIN OF EVIDENCE," and information relating particularly to the application of MORSE Silent Chain Drive to.........

.... machinery.

We are interested in a drive of about.......

h.p. for driving ....

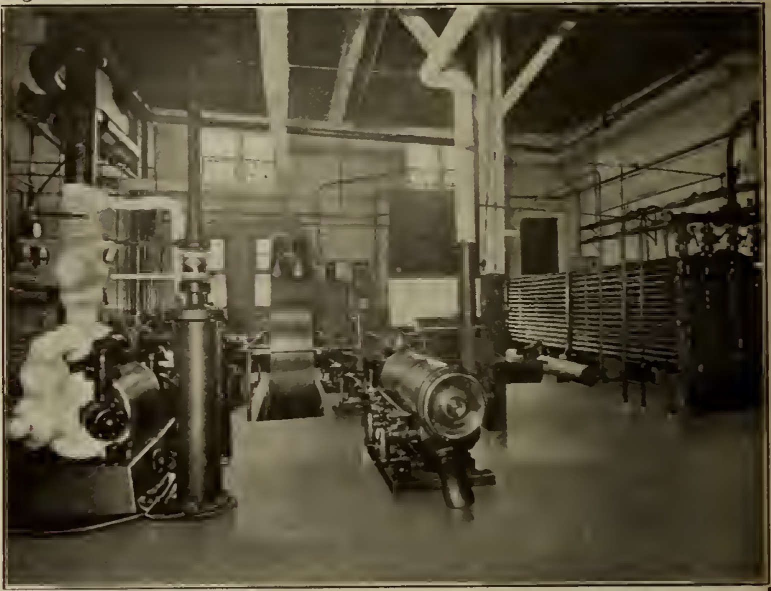
from ....

Name ....

Company ....

Address ....

S-7, Power House, April, 1916.



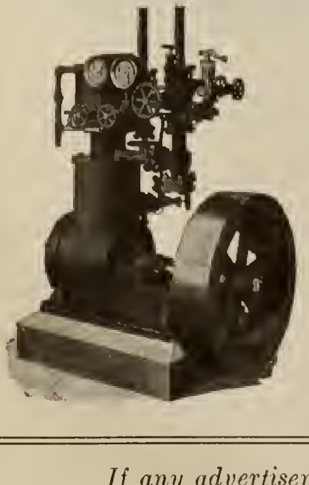
"Linde" Service

Quality of Material
Modern Design
Arrangement of Plant
Efficiency in Operation
A Proportionate Price

Linde Plants reduce the cost of production by maintaining uniform conditions and eliminating waste.

A PROVEN SYSTEM FOR EVERY NEED. ASK OUR ENGINEERS.

The Linde Canadian Refrigeration Company, Limited
MONTREAL TORONTO WINNIPEG CALGARY EDMONTON VANCOUVER
Makers of Quality Machinery in Canada since 1896.



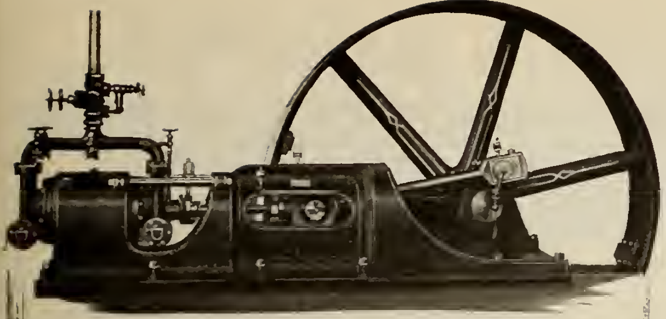
Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones. AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Corliss Engines *Special Machinery*

THE VILTER MANUFACTURING COMPANY
242 Beecher Street, MILWAUKEE, Wis. *Chicago Office:* 731 Monadnock Buildin g



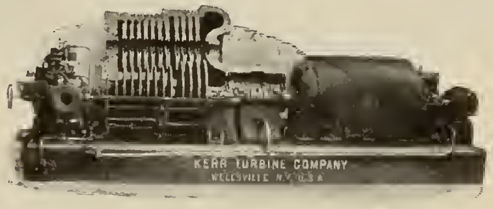
When you are in the market for a high-class ice-making or refrigerating plant, do not overlook the service and equipment which we have to offer. It is worth your careful investigation. *Your inquiry will be appreciated.*

THE HUETTEMAN & CRAMER COMPANY

Manufacturers of
Ice-Making and Refrigerating Machinery

DETROIT, 43rd Year. MICHIGAN, U.S.A.

'KERR ECONOMY'
Steam Turbines



Accessibility. Note the above photo, which shows a 500 K.W. "Kerr Economy" Turbo Generator with horizontally split turbine casing raised to show discs and rotor and accessibility of parts. Note that the discs are completely exposed down to the shaft.

Adaptability. The production of highly accurate and quiet operating "Kerr Economy" Herringbone reduction gears has greatly broadened the field of the "Kerr Economy" Steam Turbine, permitting turbines to operate at most economical speeds while driving low speed machines. They explain our many very successful geared turbines supplying power for rope or belt drive pumps, low speed generators, etc. A number of our turbines are now used to drive large reciprocating pumps through 75 to 1 double reduction gears.

KERR TURBINE COMPANY

WELLSVILLE NEW YORK, U.S.A.

Offices in Montreal, Toronto, Vancouver, Winnipeg and all large cities in the United States.

PREPAREDNESS

in the Ice-Making and Refrigerating Plant means the installation of the most Reliable and most Efficient Equipment obtainable.

THE YORK ENCLOSED REFRIGERATING MACHINE has been developed to the highest state of perfection attained by this class of machinery.

Thousands of these machines are proving their character by earning handsome dividends for their owners.

If you would have your Refrigerating Plant in the highest state of Preparedness for the coming summer, install a YORK—make the start by writing us for information and prices.

Represented in the Dominion by

Canadian Ice Machine Company

MONTREAL - 227 Coristine Building
TORONTO - - - - 82 Chestnut Street
WINNIPEG - - - 85 Lombard Street

York Manufacturing Company

(Ice-Making and Refrigerating Machinery exclusively)

YORK, PA., U. S. A.

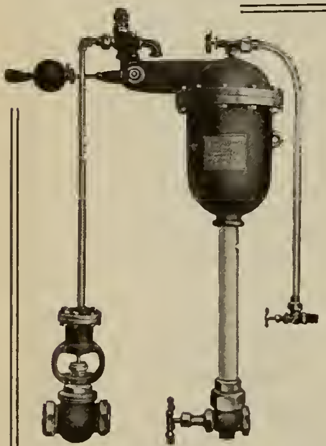
THOMAS ELLIPTIC GRATE BARS—SHAKING CIRCLE STATIONARY

Increase steam—Save fuel—Save labor—Cost less—Reduce smoke.

Shipped from Hamilton, Ont. **Let us give you complete information**

FOR ALL PROBLEMS—**Steam—Grate Bar—Furnace—write THOMAS**

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.



Floats are Objectionable

Many engineers object to floats in feed water regulators largely because floats cannot be depended upon and at their best are short lived. They shrink, frequently collapse and even become water-logged.

FREE

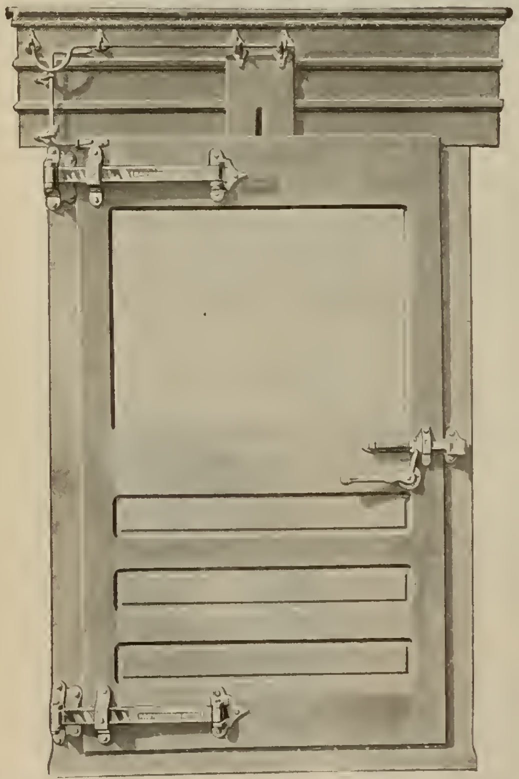
We will send you a set of Engineer's Data Cards for the asking. Just send us a postal.

The Vigilant Feed Water Regulator

is not actuated by any floating mechanism. A heavy displacement is used which is positive acting under all conditions and lasts as long as the boiler. This is another point in favor of the Vigilant automatic feed water regulator gained from long experience building this class of apparatus. Vigilant Regulators are popular with users because they are built right and can be depended upon at all times.

CHAPLIN-FULTON MFG. CO. :: PITTSBURGH, P.A.

J. V. Jamison, Pres. **T. B. South, Vice-Pres.**
J. V. Jamison, Jr., Sec. & Treas.
R. L. Jamison, Order & Ship. Dep't.



"Jones" Standard Automatic Track Door, Left Hand.

Cold Storage and Freezer Doors either Standard or Fireproof

DOOR

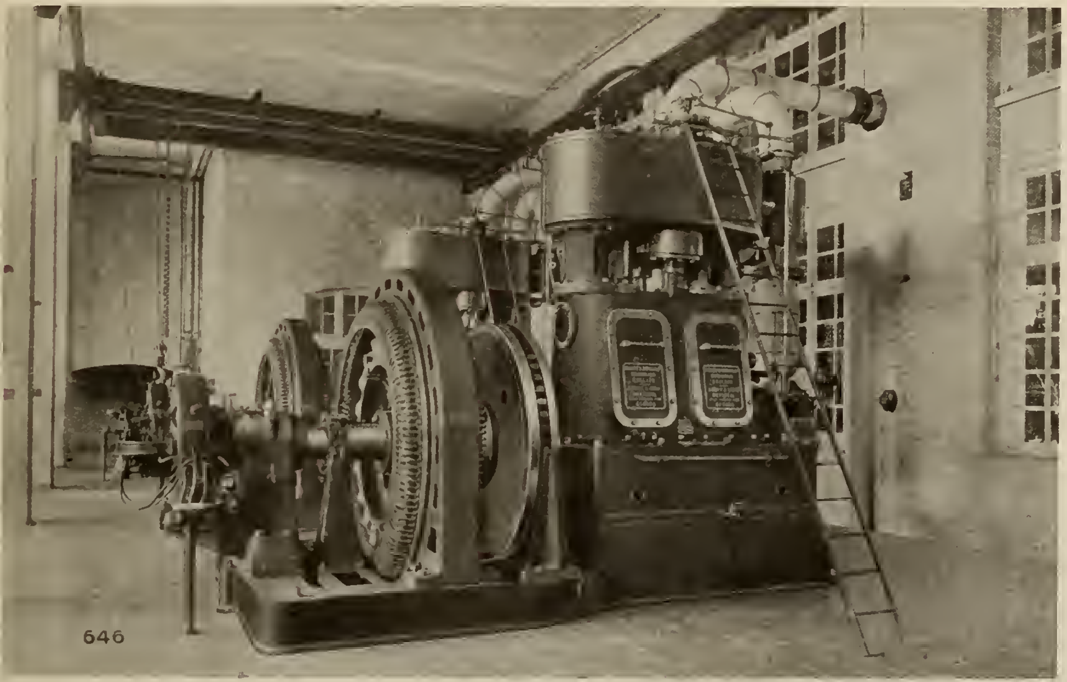
The "Jones" Door, with double seals of contact between the Door and Frame, is the heaviest constructed, most durable and best insulated Door made. Proof—Compare catalogued weights and detail sectional views, or ask P. Burns & Co., Gordon, Ironsides & Fares Co., Canadian Fish & C. S. Co., Prince Rupert; Frontenac Brewing Co., Montreal, Quebec, Canada; Canadian Government Agricultural Dept., or any other large users of Doors of National or International importance. Most of them say "the Door that gives us the least trouble is the 'Jones.'" Built for strength and durability.

We have a new 96-page illustrated catalogued treatise on Insulated Doors. The most complete ever issued, free for the asking. It describes, in addition to the above:

The "Jones" Cold Storage Window.
The "Jones" Automatic Ice Recording Doors and Chutes.
The "Jones" Platform Ice Passing Chute and Door combined.
The "Noequal" All Steel Automatic Ice Chute.
The "Noequal" Revolving Ice Cream Passing Door (Wood or Steel)
The "Jones" Vertical Sliding Door.

Jamison Cold Storage Door Co.
Formerly JONES COLD STORE DOOR CO.
HAGERSTOWN - MARYLAND, U.S.A.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



2-400 Kilowatt Belliss & Morcom High-Speed Engines.
MONTREAL NEW JAIL. BORDEAUX, QUE.

WE HAVE FOR IMMEDIATE DELIVERY, A NEW ENGINE GENERATOR SET, AN EXACT DUPLICATE OF THE ABOVE. WRITE FOR PARTICULARS.

Send Us Your Enquiries For

CENTRIFUGAL PUMPS

Steam Engines, Boiler Feed Pumps, Condensing Plants, Producer Gas Engines, Air Compressors, Oil Engines, Steam Turbines, V-notch Water Meters.

Complete Power Plant Equipment.

We can offer a large assortment of machinery for immediate shipment

LAURIE & LAMB

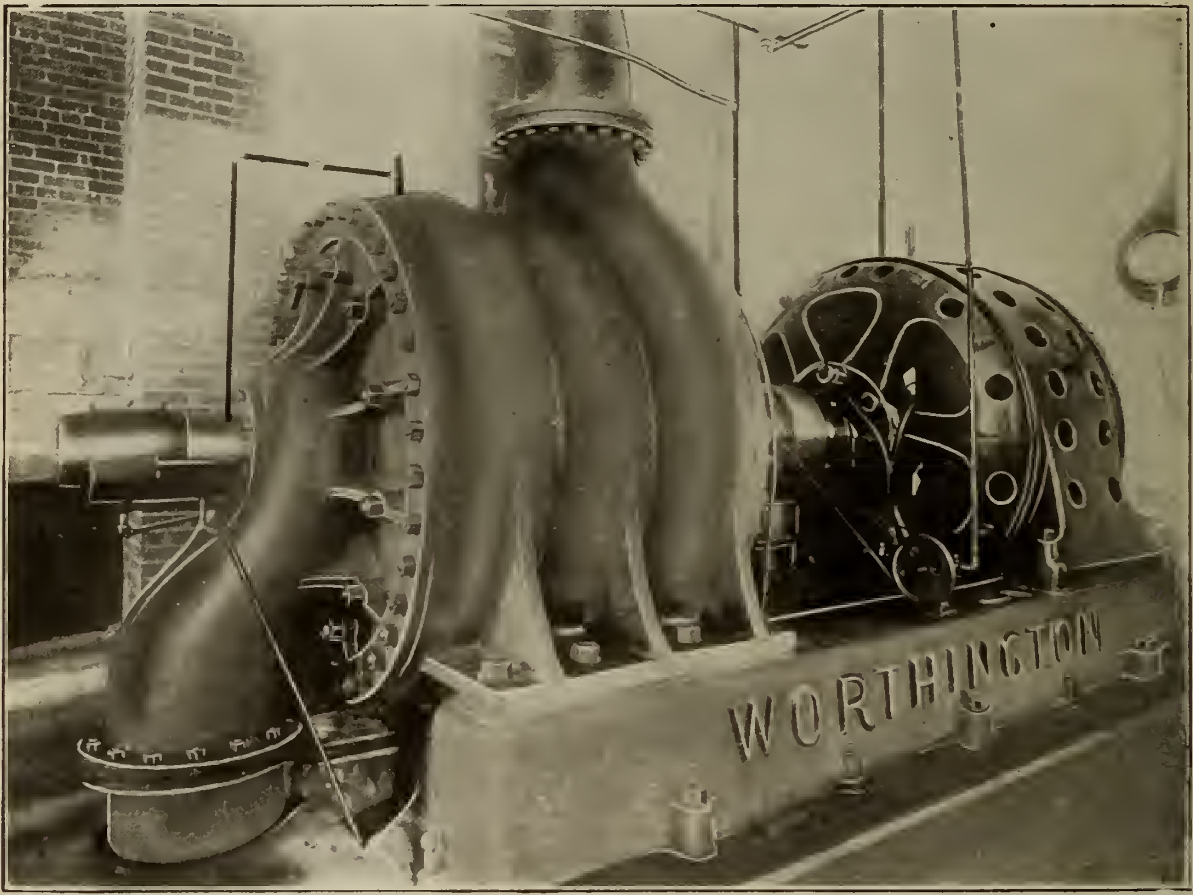
Engineers

211 Board of Trade Bldg. :-: :-: MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps—centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

The Publisher's Page

By B.G.N.

I was talking a day or two ago to one of Canada's most prominent advertisers in the engineering field. The subject was advertising.

"We are sold up now for several months and I cannot see how we can very well increase our capacity or our facilities for turning out our product," said this successful manufacturer.

"In spite of this, however, we are going to continue our advertising week in and week out and year after year, and we are going to do more advertising if anything—certainly not less. We are not going to quit.

"I started in this business thirty years ago," he continued, "and at one time I personally knew every firm from whom we purchased material and supplies. As promotion came I lost touch with our transactions with these firms and in a comparatively few years I was signing checks payable to concerns which I had never heard of when I was purchasing agent.

"New firms are constantly being established, new factories being built, new men being placed in charge of them. It is to reach these men long before they acquire purchasing power that we are advertising so aggressively to-day.

"I want to reach the apprentices, the ambitious mechanics, the young fellows in the offices who some day, perhaps in the near future, may acquire authority and possibly own businesses of their own."

The advertiser in question said many other things regarding pertinacity of purpose in promoting prosperity through publicity. He preached as fine a sermon on advertising as one could wish—clear, convincing and bristling with incidents from his own experience as a successful advertiser. I would like to tell the whole story but there's sufficient meat in the part I have related to keep a thinking man busy and a busy man thinking. The moral of it is worth real money. I wish I felt at liberty to give you the advertiser's name—it would, perhaps, add strength to the story.

Power Equipment

Steam Engines and Turbines, Return Tubular and Water Tube Boilers, Heaters, Pumps and Condensers

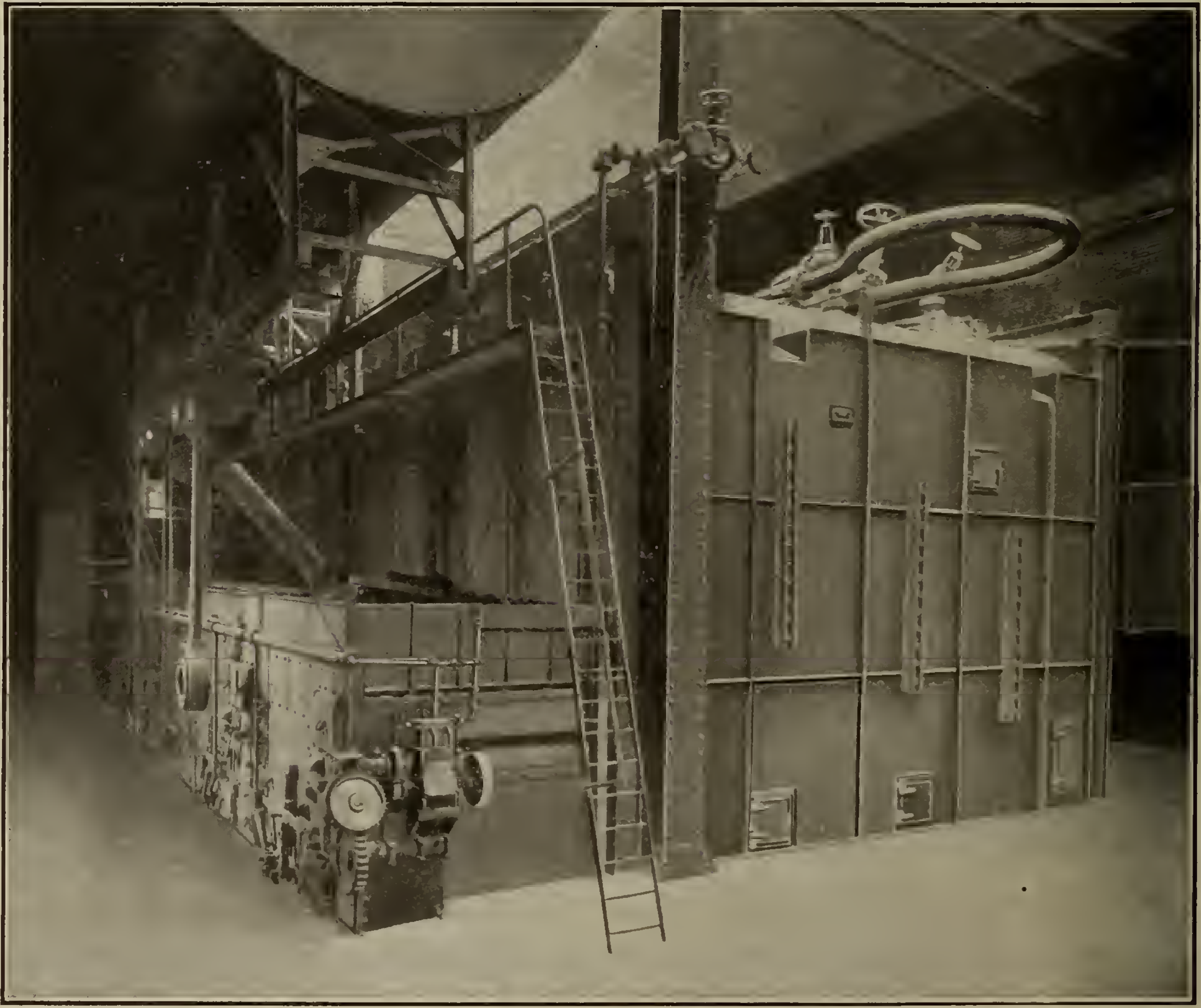


Illustration shows the Boiler Room at the New Asylum for the Insane, Whitby, Ont. equipped with 4 G. & McC. Co. Sectional Water Tube Boilers.

The Construction of G. & McC. Co. Water Tube Boilers meets the demand for higher quality. EVERY PART SUBJECTED TO STEAM PRESSURE IS MADE OF FORGED STEEL. They excel in positive and rapid circulation and in increased Steaming Capacity. Ask for our catalogue and more detailed information if interested.

THE GOLDIE & McCULLOCH CO., LIMITED

Head Office and Works : GALT, ONTARIO, CANADA

TORONTO OFFICE:
Suite 1101-2 Traders Bank
Building.

WESTERN BRANCH:
248 McDermott Ave.,
WINNIPEG, MAN.

QUEBEC AGENTS:
Ross & Greig, 412 St. James St.
MONTREAL, QUE.

BRITISH COLUMBIA AGENTS:
Robt. Hamilton & Co.,
VANCOUVER, B.C.

Montreal High School Heating and Ventilating Equipment

Staff Article

Nowhere is the old adage 'A sound mind in a sound body' more consistently verified than in these modern temples of learning with which the youth of the western hemisphere is being so prolifically supplied. The problem of maintaining living conditions at that state which is most conducive to brain activity receives increasing attention every year, and the plant described herewith is a recent example of this branch of engineering.

IN the construction of large buildings, especially where large numbers of people are constantly gathered together, one of the most essential factors is that of proper ventilation. In former years the question of ventilation was left entirely to the discretion of the room occupants, but science has demonstrated that mechanical ventilation, properly installed, is not only more satisfactory, but more economical and healthier.

While the temperature is an important feature in connection with proper ventilation, it is not the most essential. Dry air at a temperature of 65 degrees might be almost unbearable; therefore, it is readily perceived that proper conditions cannot prevail unless the atmosphere contains a certain percentage of moisture. By mechanical means this humidity can be so proportioned in relation to the temperature that perfect ventilation is assured.

The system recently installed in the new High School of Montreal is one of the most modern and up-to-date in the Dominion.

This four-storey building, containing 62 class rooms, large gymnasium, dining room and numerous other rooms and corridors, can be satisfactorily treated at a minimum of labor and maintenance costs.

Boiler Room Equipment

The boiler room equipment consists of a battery of six Goldie & McCulloch 150 h.p. return tubular boilers, fitted with the latest type of Murphy stokers. Provision is also made for two additional boilers, when the contemplated extensions are made to the main building. The object of the high pressure installation was for the purpose of taking care of future possibilities; the original intention of the school authorities being to ultimately manufacture their own operating power. Present conditions, however, only call for low pressure steam for heating purposes. The draught is automatically controlled by a Stillman-Carmichael damper regulator, which operates in connection with a damper placed in the main smoke flue leading from the boiler to the stack.

The steam from the boilers passes into a large header 26 inches in diameter, and the full length of the boiler room. From this header a 20-inch main carries steam to the ventilating apparatus, and an 18-inch main feeds direct to the heating system throughout the building.

Special Youghingheny coal is used in firing the boilers. This coal, which is stored in a pit of 1,000 tons capacity, is loaded on a special ball-bearing Mussens truck, of one ton capacity, and elevated to the track above the furnaces by means of a hydraulic lift. Bunkers are provided above the mechanical stokers for holding the coal preparatory to being fed to the magazines. The Murphy stokers are operated by two 7 h.p. a.c. variable speed motors, each motor operating a set of four stokers.

All return water from the heating system is taken to a tank of 5,000 gallons capacity. From this tank the water is fed back to the boilers at a temperature of about 120 degrees by means of two John McDougall 16-inch centrifugal pumps, each of which is direct connected to a 7 h.p. a.c. motor. All motors in the building were manufactured by Bruce, Peebles & Co., of Edinburgh, and installed by Roper, Clarke & Co., of Montreal. A view of the feed water pumps is shown in Fig. 2.

The blow off from the boilers passes into a large tank, from which the water is discharged to a sump pit, and thence pumped to the sewer—which is several feet above the level of the basement floor—by a John McDougall 16-inch vertical centrifugal pump, direct connected to a 7 h.p. motor. A similar unit takes care of all waste water from sinks, wash basins, shower baths, etc.

Power Control

Two separate sources of electric power are available—one from Shawinigan and the other from Chambly. The current enters the transformer room at a voltage of 2,200, and is stepped down to 220 for motors and 110 for lighting. Adjacent to the transformer room is the main switch board room, shown in Fig. 3, which controls all auxiliary units throughout the building.

The total power used to operate the system is 260 h.p., arranged into five separate circuits, each of which is controlled by individual circuit breakers. When trouble occurs and the outside power is shut off, each section can be operated

NEW HIGH SCHOOL, UNIVERSITY STREET, MONTREAL.

as a separate unit, thus avoiding any unnecessary delay in starting the entire system.

A separate fan, 30 inches in diameter, driven by a 5 h.p. motor, with variable speed control, is used for circulating air through transformer and switch board rooms. This is especially necessary in hot weather to keep the temperature down.

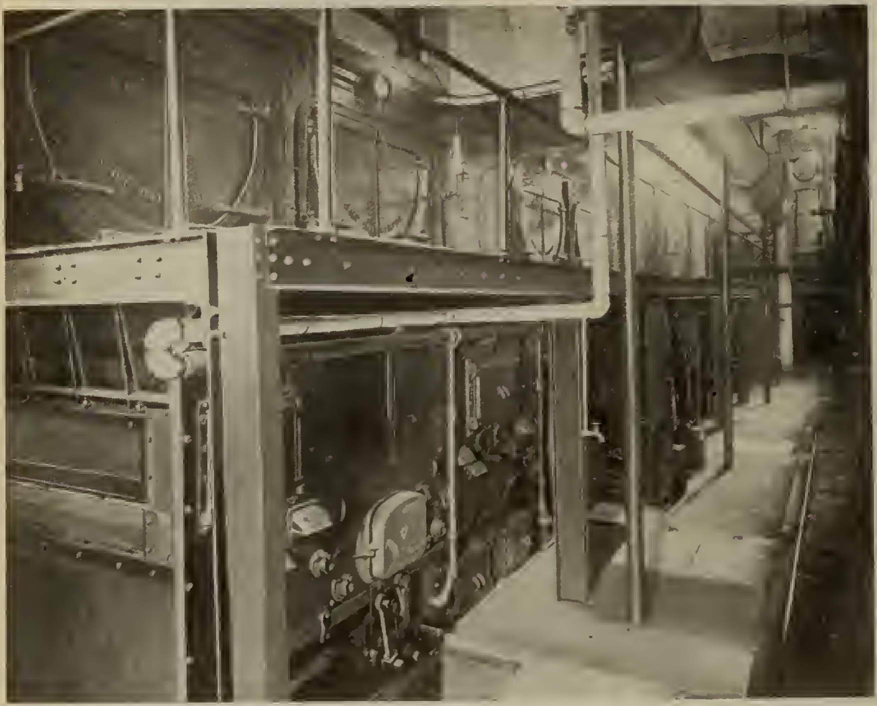


FIG. 1. VIEW IN BOILER ROOM SHOWING FIRING FLOOR.

Washing and Purifying the Air

In order to reduce impurities to a minimum, the air is taken from the outside, a wall 10 feet high, covered with wire screen, being built to avoid any heavy dust or dirt being taken into the building. The air is drawn through baffle plates into a chamber 18 feet square and 10 feet high. One of these rooms supplies two of the 9-foot fans From this room the air passes through a series of steam coils, which heat the air, raising the temperature from that of the outside atmosphere to a temperature of 55 degrees. The air now passes through a sheet of water—formed by the action of a large number of sprays—for the purpose of removing any particles of dirt and other impurities. This foreign matter, after being eliminated from the air, drops into a receptacle at the bottom of the washing chamber. In addition to the first washing, the air is further purified by passing through numerous baffle plates, over which water is continually running. After passing through this second curtain of water, the air, now containing about 35 per cent. of moisture is again heated and raised to the desired temperature of about 65 degrees. It is then drawn through the 9-foot Keith fans, and forced through the ducts to the various rooms.

The water for the air washing process is kept in continual circulation by means of the pump shown in the foreground of Fig. 4. This 12-inch centrifugal pump is driven by a 6 h.p. a.c. motor. The water, as it is forced to the washing apparatus, passes through the strainer shown, which retains all foreign matter. These strainers, and also the receptacle in the washing rooms, are thoroughly cleaned at least once a week.

To prevent the possibility of ice forming in the washing room during very cold weather, steam can be admitted to the washing water in sufficient quantity to prevent freezing.

The Carrier air washing system was installed by the Buffalo Forge Co.

Air Distribution

Fresh air is supplied to the entire building by seven large Keith fans; one, 10 feet diameter and 5 feet wide, belt-driven by a 24 h.p. variable speed motor; five, 9 feet diameter, 4 feet 6 inches wide, driven by 20 h.p. motors.

A special 8 feet diameter, 4 feet 6-inch fan, supplies air for the gymnasium at a temperature of 55 degrees.

The total amount of fresh air supplied into the building by all blower fans is approximately 278,500 cu. ft. per min., or about sixteen and one-half million cu. ft. per hour. This accomplishes about seven changes of air per hour, and provides for fresh air supply at the rate of about 35 cu. ft. per min. for each occupant, on a basis of a class room accommodation of thirty pupils per room.

The rate of change in corridors and rooms other than class rooms varies from 4 to 8 per hour.

All these fans are operated by variable speed motors with six speeds, the fourth being sufficient for present conditions.

A view of the large 10 ft. Keith ventilating fan in operation is shown in the left background of Fig. 5. This fan (like all the others) can be operated at six speeds; the slowest at a speed of 95 r.p.m. gives a delivery of 50,000 cu. ft. of air per min., while at top speed the delivery is 65,000 cu. ft. at a speed of 143 r.p.m.

Unlike the ordinary run of ventilating systems—where main ducts are carried to certain floors and sections—the system in vogue throughout this building is to run a separate and distinct duct from the basement main to each ventilator. The main object of this method was to eliminate all unnecessary sound passing from one class room to another.

Exhaust Ventilation

In the toilets, effective exhaust ventilation, amounting to about 20 changes of air per hour, is maintained by means of exhaust fans located on the fourth floor. No fresh air is supplied into the toilets by the ventilating apparatus, as these rooms are kept under a strong suction to prevent the escape of objectionable odors. There are two large exhaust

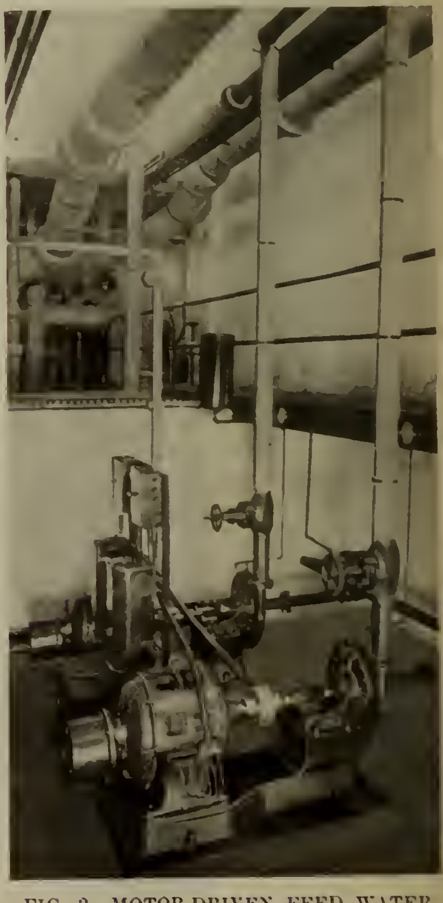


FIG. 2. MOTOR-DRIVEN FEED WATER CENTRIFUGAL PUMPS.

fans from the toilet exhaust system, one in each section, each fan discharging approximately 21,000 cu. ft. of air per min.

A separate exhaust fan is provided for the removal of cooking odors from the kitchen. This fan discharges about 8,000 cu. ft. of air per hour and effects about 25 changes in the same time.

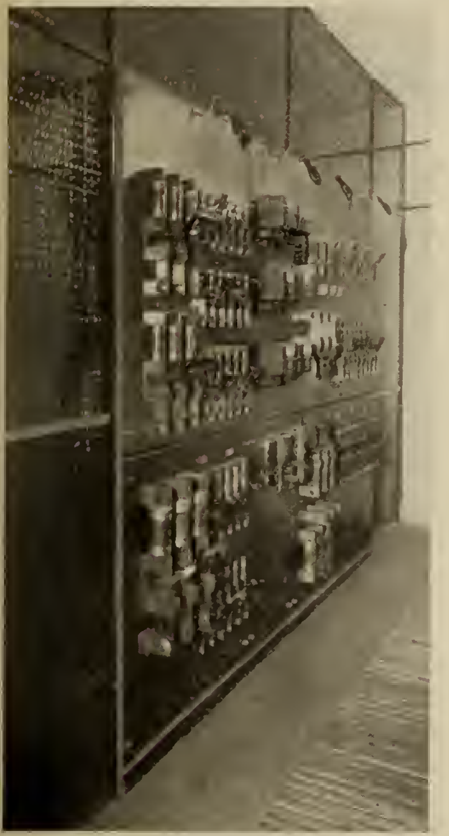


FIG. 3. MAIN SWITCHBOARD.

System of Air Control

Fig. 5 shows a view of the two Powers air compressors, chain-driven by two 5 h.p. motors. These supply air at a pressure of from 15 to 20 lbs. for operating the regulating system. These pumps are controlled automatically; when the pressure in the reservoir is reduced to 15 lbs., the action of two springs operates a lever, which in turn throws the switch into position and the pump operates, until the pressure of air overcomes the tension on the springs, and the switch is thrown out of contact. The automatic starting and stopping of these pumps requires a very serviceable chain drive, as the action of the continual intermittent operation causes a severe strain upon the chain. These chains, and also those on the exhaust fans, are of the Reonolds type.

This air is delivered through $\frac{1}{8}$-inch pipe to all the regulators throughout the entire system. These pipes are also connected to a thermostat in each room, the action of which is governed by the temperature of the room. When the heat of the room drops below the desired temperature the thermostat operates a pin valve, which allows the air to escape from above the regulator and steam is permitted to enter the coils. When the desired temperature is again reached, the expansion of the thermostat will close the valve, and the pressure of air will force the piston of the regulator down and close the steam valve.

An interesting feature in connection with this installation is the control of all main ventilators and skylight coils from a push-button switchboard, located at the entrance to the boiler room. The regulators on these coils and ventilators can be operated from this switchboard without the necessity of going to each separate section of the building.

It might be here stated that no tampering can be done by the pupils or the teacher on any parts of the regulating system. The desired temperature is decided by the principal, and the control of the system is in full charge of the engineer

Duplicate Installation

In view of the possibility of trouble arising in connection with outside supply, the school authorities have amply protected themselves by a duplicate installation of electric power, gas and water requirements. The present supply of water is derived from the High Level reservoir, which delivers water to the school at a pressure of 150 lbs. per sq. in., which is reduced by a Mason regulator to a pressure of 60 lbs. per sq. in.

A Webster heater is used to heat all water for shower baths, washing purposes, etc. In connection with this heater is a reserve tank, having a capacity of 1,200 gallons. All hot water and return pipes are of brass and fitted with Jenkins valves. It might be noted here that Jenkins valves are used throughout the entire system, 282 being in the heating system and 146 in the plumbing.

A feature of special interest worthy of mention is the system of painting the pipes of different colors to indicate the purpose for which they are used; by this method much delay can be avoided when valves are to be located for specific purposes. This is often an essential factor when it is considered that there are many miles of piping and hundreds of valves throughout an installation of this description.

A chart, giving the number and purpose of every valve in the building, hangs in the engineer's office, and the location of any valve on the system can be quickly ascertained.

The plumbing was installed by the general contractors, Garth & Co., Montreal; the boiler equipment by Ross & Craig, Montreal; Motors by Roper, Clarke & Co., Montreal; the air ventilating ducts by Douglass, McFarlane, Montreal; the ventilating fans by Sheldons, Ltd., Galt, Ont. The consulting engineers were Nygren, Tenney & Ohmes, New Birks Building, Montreal, and the operation of the system is in charge of Mr. Jas. Carmichael, engineer of the plant.

PHENOMENA OF ENGINE CYLINDER WEAR

IN modern high-speed steam and internal-combustion engines, cast iron, says "Engineering," is, up to the present, the only metal which has given satis-

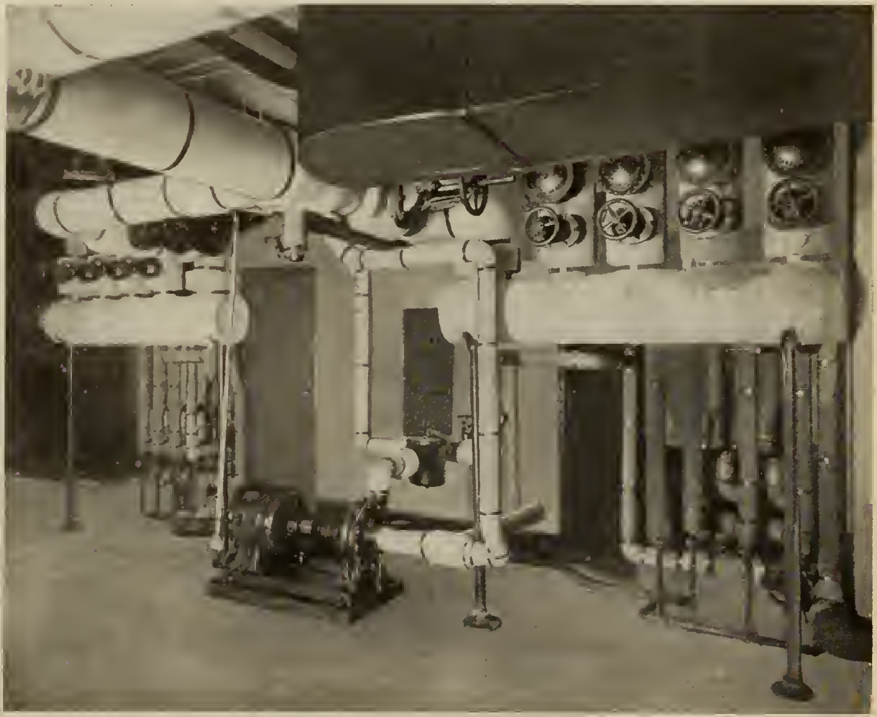


FIG. 4. SHOWING, IN FOREGROUND, 12-IN. CENTRIFUGAL PUMP FOR WATER CIRCULATION OF AIR-WASHING SYSTEM.

factory working results when used for the construction of certain vital parts, such as pistons, piston-rings, and cylinders. This fact, coupled with the serious drawbacks of cast iron in other ways, is sufficient to prove the tremendous importance of a careful study of this subject. The two chief properties required of cast iron for the purposes named are maximum resistance to wear, and the most perfect running properties under the conditions existing in the engine. The mechanical properties, such as the tensile and transverse strength, can usually, without much difficulty, be obtained sufficiently high to withstand the stresses involved in the use of the generally accepted thicknesses of material employed.

Weight and Tensile Strength

The modern tendency, however, seems to be to cut down the weight of members to a minimum, and for this reason higher tensile strength irons will be more and more in demand. The wear in the particular case of engine cylinders is the loss in weight sustained by the cylinder under the action of the piston. The running property of an engine cylinder is a peculiar property whereby the cylinder is enabled to give the most satisfactory results in actual working from the point of view of absence of trouble from overheating and galling or seizing.

In the ideal engine the piston proper is separated from actual contact with the cylinder by a thin film of lubricant, and the piston-rings alone are in actual contact, scraping the surface of the liner. When in action the piston does not exert a constant and equally-distributed pressure over the whole surface of the cylinder, but by the reaction of the connecting-rod at certain positions the surface of the liner is subject to alternately varying loads, which act at portions of the liner surface in the vertical plane.

The wear of the cylinder is generally supposed to vary with the hardness — that is, under a constant load. The engineer is often confronted with cylinders rejected for excessive wear, in which the hardness is identical with other sets which are running perfectly well; and in records of liner failures it is very often an impossiblity to correlate the hardness figures and the wear. In composite metals, such as cast iron, in addition to the hardness numeral, the surface structure and arrangement exert a tremendous influence on the wear. The surface is composed of soft, ductile, and tenacious grains, together with hard and brittle grains, broken up by numerous graphite plates. Under the continuous rubbing action, these grains, which are very weakly cemented together by the graphite plates, become loosened, and eventually detached.

Worn Liner Disclosures

An examination of worn liner surfaces under the lens shows the slight loosening of the grains under the alternating action of the piston. This dislocation of the grains is in all probability brought about mainly by the direct abrasive action of the piston-rings, assisted by a sort of fatigue brought about by the vibratory motion of the piston, which assists in the loosening of the grains.

At the same time as this dislocating action is taking place, another action, somewhat different in character, is also going on. This action is practically identical with that of polishing microsections in bas-relief, and is in all probability due to the action of the piston proper, together with the polishing action of the suspended powder resulting from the first-named action. The effect of this is that the harder phosphide, eutectic and cementite grains stand in relief. These hard points, under the influence of the former dislocating action, in a like manner become detached, and with the constant repetition of this action the total wear is increased. Our contemporary further considers the means which should be used in casting and machining cylinders in order to minimize these tendencies to wear.

* * *

Title of Engineer in Austria.—A movement is at present on foot in several countries to confine the "title" of engineer to those who really are entitled to it by having passed the examination at a technical high school. The Austrian Minister for Public Works has now decreed that the title of engineer cannot be registered in connection with firms, etc., unless the person in question has the proper qualification—the passing of the examinations at a technical high school. The argument is that the registration constitutes a kind of official acknowledgment.

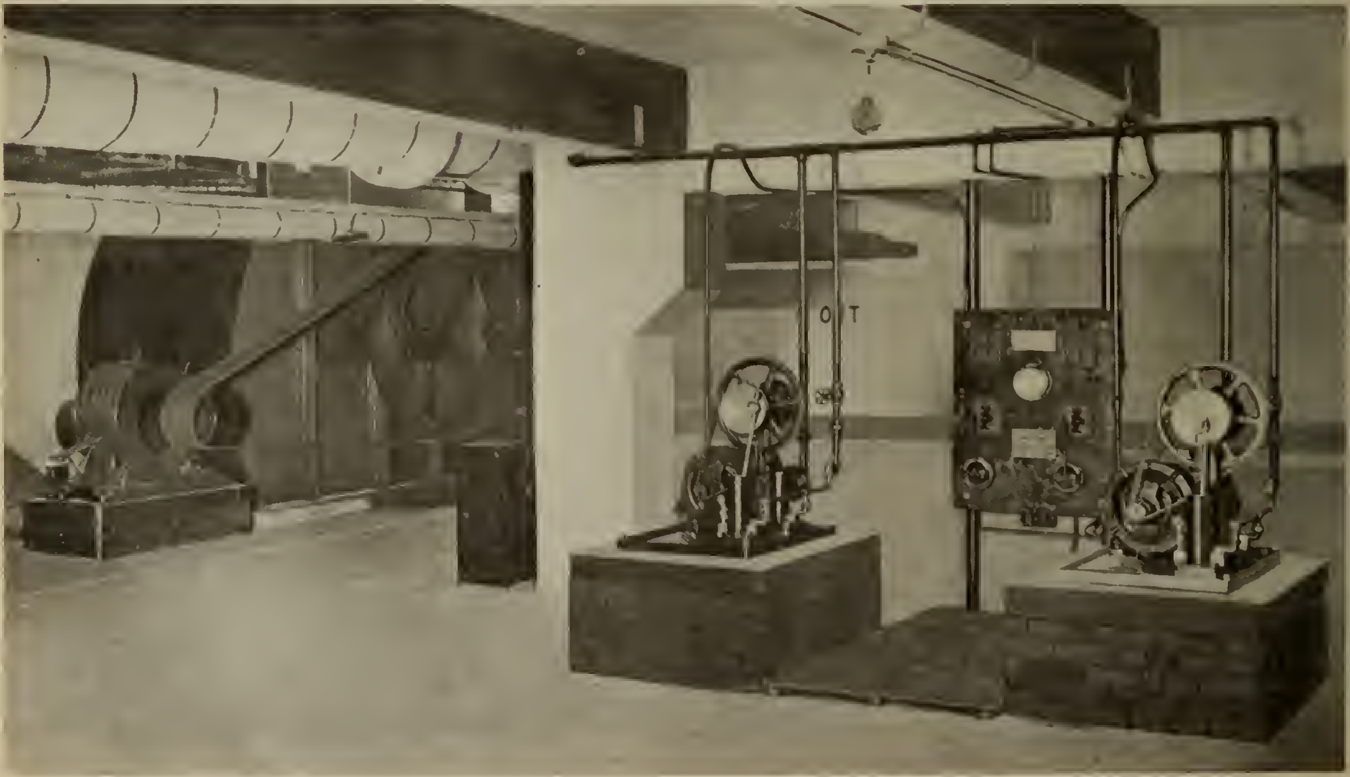


FIG. 5. SHOWING MOTOR AND CHAIN-DRIVEN AIR COMPRESSORS, ALSO 10-FT. BELT-DRIVEN VENTILATING FAN.

Power Transmission Section

THE INSTALLATION AND MAINTENANCE OF TRANSMISSION BELTS

To obtain, and maintain, the highest possible efficiency in power transmission, has been, and still is, an unsolved problem. Many substitutes for leather belt transmission have been devised, and have met with varying degrees of success, but nothing has as yet been produced, that for general, all-round purposes can oust leather belting from the leading position. If the question of belt-driving is given equal consideration with many other forms of transmission, it will demonstrate beyond question its greater efficiency and economy. Wherever practicable the care of all belting should be under the supervision of one man. When this work is left to each individual machine operator the efficiency of belting becomes a minus factor. With the problem in the hands of one capable man there is the assurance that experience will evolve ways and means to obtain the maximum efficiency from the belts under his charge.

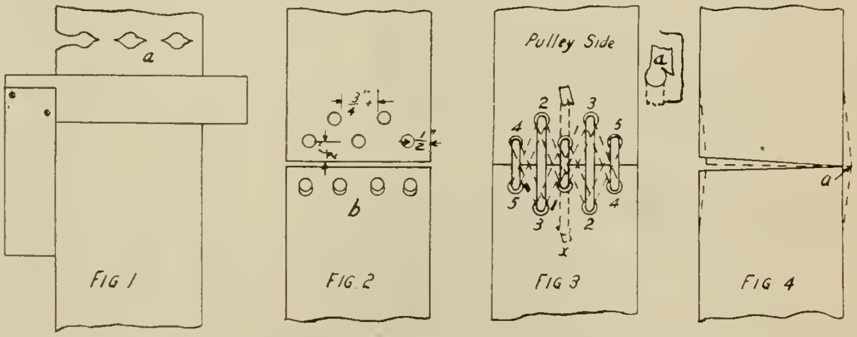
In the following article several details in connection with the use and abuse of belts and pulleys are set forth which may be profitable to those having the care of belts and accessories.

Trimming and Punching Holes

When trimming a belt preparatory to lacing, always have the ends cut perfectly square; the proper joining of the ends of a belt is a question of paramount importance, and satisfactory operation is largely dependent upon the manner in which this work is performed. The correct way is to mark off the belt by means of a try-square, as shown in Fig. 1. By this method there is assurance of an even joint which will pass over the pulleys smoothly.

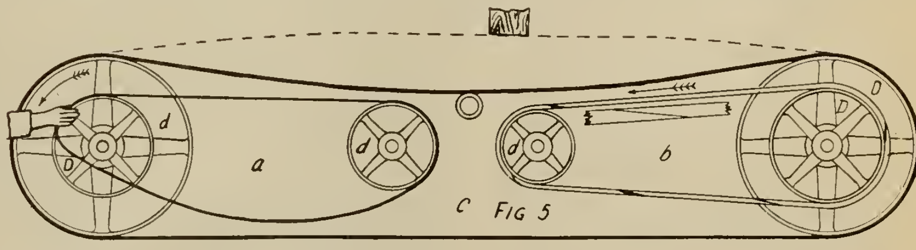
If proper attention is overlooked in this connection there is a possibility of producing a joint similar to that shown by the dotted lines in Fig. 4. When this bulge (a) reaches the pulley, the tendency is to run off—or in the case of cone pulleys—to climb to the next step.

One of the most important factors in connection with efficient belt service is the proper use of the belt punch. By closely observing an old and worn joint it will be noticed that the holes have a shape similar to that shown at (a) Fig. 1. This shows that the tension of the lace causes rupture, through the holes, "across" the belt; very seldom will the lace pull out through the end of the belt. Therefore, it is advisable to provide plenty of space between the holes; good practice under general conditions would be an allowance of at least ½ inch between the end and the holes, and a similar amount on each edge, with from ¾ inch to 1 inch between the holes; if it is necessary for a double row of holes the second row should be about ¾ inch back of the first row.



TRIMMING AND LACING THE BELT.

In the advent of an extra heavy lace being used it sometimes becomes necessary to enlarge the holes. From the above it is evident that the enlargement should extend lengthwise of the belt, as shown at (b), Fig. 2. Never use a punch larger than absolutely necessary, as every additional bit of stock removed only weakens the belt. The selection of a suitable lace should be given careful consideration. A thin strong lace is to be preferred to a heavier one of the same strength, as in the majority of cases it is the belt that breaks through the holes before the lace is broken.



DIRECTION OF BELT TRAVEL AND PULL. PLACING BELTS ON THE PULLEYS.

Lacing the Belt

Numerous methods are used for the joining of transmission belts, but the one generally adopted, and the most satisfactory, is that of leather lacings. Many rules have been formulated for the lacing of belts; in fact, is would appear that every other mechanic has a different process. However, the course usually followed is shown in Fig. 3.

It might be stated here that the generally accepted rule is to run the hair or smooth side of the belt on the pulley. This, however, is an open question, as experts seem to differ on the subject.

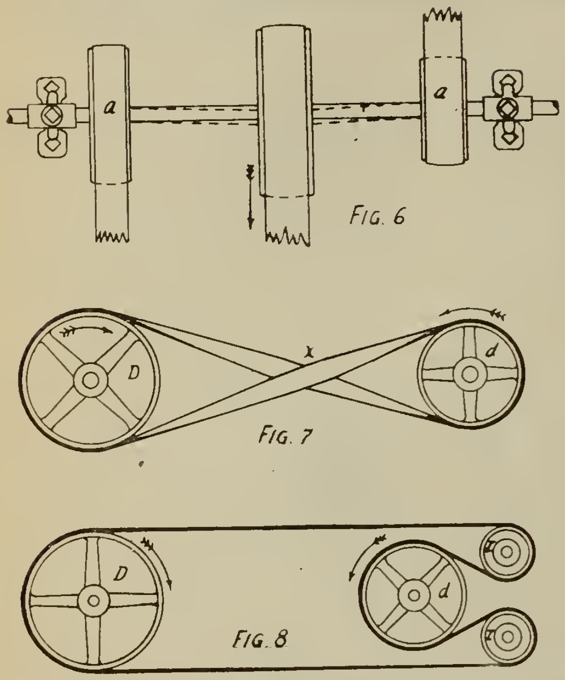
When lacing a belt, it is always advisable to keep the lace on the inside parallel with the travel of the belt. To attain this proceed as follows: Insert the lace as shown in the two centre holes 1 and 1, keeping the straight portion on the side that is intended to run on the pulleys. With the ends of the lace of equal length, proceed as indicated in Fig. 3, working from each side simultaneously, 1-2-3-4-5-4-5-2-3-1-x. The hole x should be a tight fit for the lace, and when the lace is finally drawn through x, it should be notched and cut, as shown at (a). This, when properly done, acts as a good reliable lock for the lace ends. The use of knots is often resorted to, but is gradually being discontinued. When the joint is completed it may be slightly pounded with a wooden mallet, to flatten the lace before placing the belt on the pulleys.

Direction of Travel and Pull

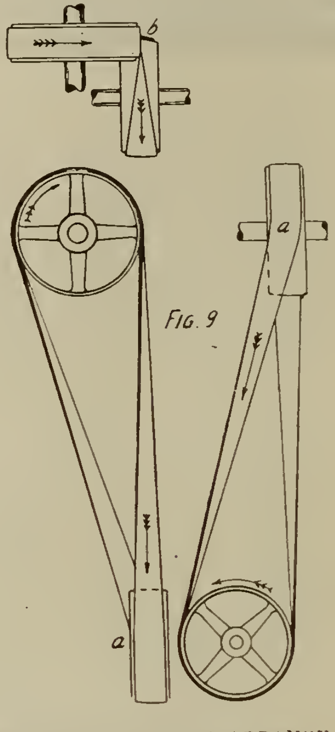
As leather belts are made of short

sections, joined together with a long wedge-shaped cemented splice, it is sometimes deemed wise to place the belt on the pulleys, so that this splice will lie as shown at (b), Fig. 5.

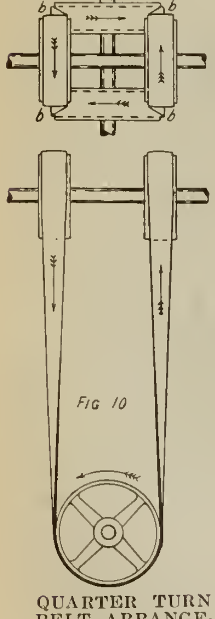
When dampness or other causes affect this joint so that the cement begins to slacken up, the thin end of the joint shows a tendency to curl, and by placing the belt as shown this trouble can be largely prevented, the action of the belt travel helping to keep the thin edge rolled down.



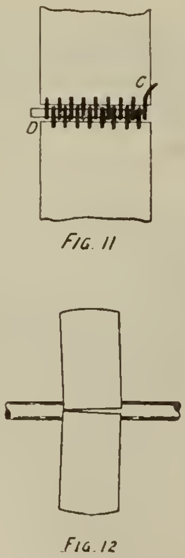
SHAFT SPRING, CROSSED BELT, AND CHANGE OF ROTATION DIAGRAM.



QUARTER TURN BELT ARRANGEMENT, TWO PULLEYS.



QUARTER TURN BELT ARRANGEMENT, FOUR PULLEYS.



METAL JOINTS AND WOODEN PULLEY TROUBLE.

When putting on a belt always place it over the dead—or, in other words, the driven pulley first; then from the back of the driving pulley D, the belt can be drawn on with the hand, as shown at (a) Fig. 5. Under no conditions should a person stand between the driving and the driven pulleys when putting on a belt. Some men advocate the use of a stick for this purpose, and in the hands of an experienced person it may have its advantages, but unless great care is exercised in handling the same, the risk of injury from the stick being caught will be as great, if not greater, than the use of the hand method. Where the belt is exceedingly tight, or long and heavy, it is best to shut off the power and perform the operation at very slow speed.

To derive a maximum amount of power from a belt drive the pull should come upon the lower portion of the belt, as by so doing the slack will sag on the upper half, giving increased belt contact on the pulleys. It is also advisable that wherever possible the direction of pull should be evenly distributed along a line of shafting. From this it is clear that with a main line operating numerous counter shafts on each side (with open belts) the slack of the belts on one side will be on the top and those on the opposite side will show sag on the lower portion.

Belts Too Slack or Too Tight

There are those who advocate a very slack belt with plenty of belt dressing, but under ordinary conditions it is not profitable to run a belt either too slack or too tight. A very slack belt will have a tendency to slip or flop when sudden loads are applied, and an extremely tight belt will cause undue strain upon the shafts and bearings. This is emphasized when the pulley is midway between supports, as shown in Fig. 6; the dotted line showing an exaggerated condition under such circumstances.

Driving pulleys for heavy duty, or when subjected to sudden loads, should always be placed as close to a hanger as possible, as shown at (a) Fig. 6.

When the slack of a belt is subjected to continual flop or oscillation, care should be taken that no pipes, beams or other obstructions come in contact with the belt, as the constant rubbing or striking will in time destroy the belt and cut the lacings.

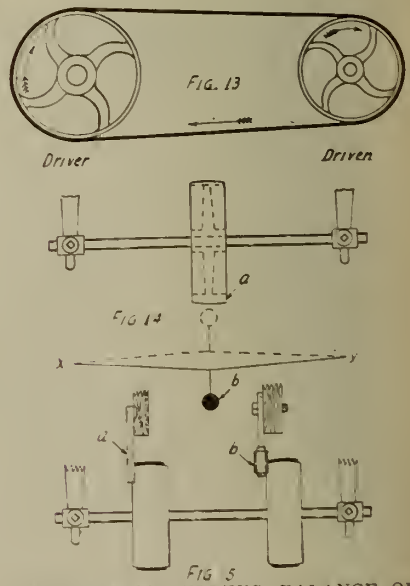
Changing Direction of Rotation of Parallel Shafts

Where it is necessary to change the direction of rotation of two parallel shafts, crossed belts are used, as shown in Fig. 7. It is advisable that the rubbing faces at (x) should be the inside or pulley side of the belt, as the laces on this side are smoother and not so liable to wear as the outer parts of the lace. When the load is applied, crossed belts will often show a tendency to run off the pulley; this can sometimes be remedied by twisting the belt in the opposite direction.

A change of rotation may be obtained by the method shown in Fig. 8 by the use of two idlers, I-I. This, however, necessitates the belt running on both sides.

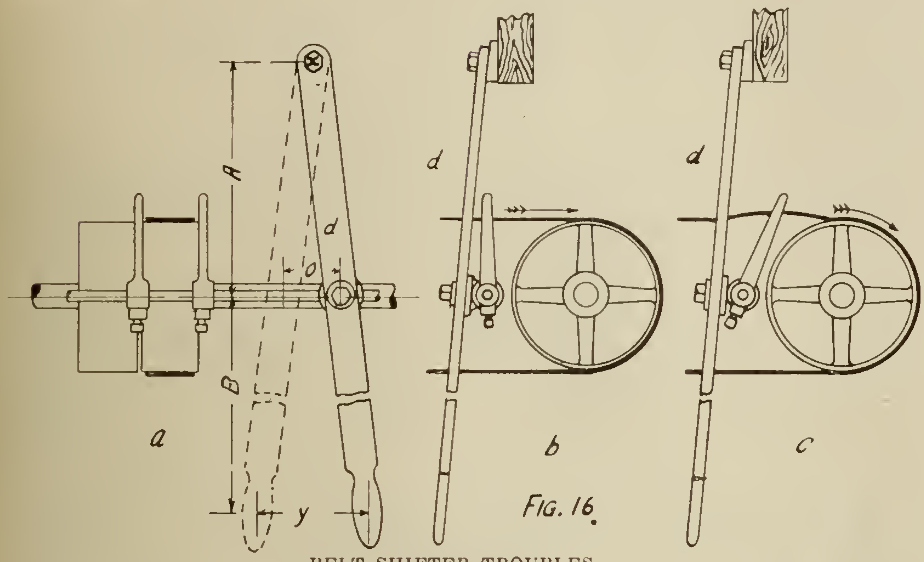
Quarter-Turn Drive

Where it is desired to drive a shaft at right angles to another shaft various methods have been adopted; but the one generally used is that shown in Fig. 9. The principal objection to this drive is the constant fibre strain set up in the belt, due to the angle formed as it leaves the pulley at the points (a, a), also the fact that the rotation is only possible in



CURVED ARM PULLEYS, BALANCE OF PULLEYS AND BELT GUIDES.

one direction (that indicated by the arrows). The chief consideration in laying out a quarter twist drive is that the points (a, a) where the belt leaves the pulleys should lie in the same vertical line, as shown at (b). This rule also applies to all angular horizontal drives.



BELT SHIFTER TROUBLES.

Another method of quarter-turn drive, involving the application of four pulleys, is shown in Fig. 10. The same principle applies in this case as that shown in Fig. 9, viz., the point where the belt leaves the pulleys should be in the same vertical line. It will, however, be noticed that in this figure the belt can be run in either direction. It will also be observed that the two pulleys on the one shaft are travelling in opposite directions, which indicates that one will be a driving pulley and the other will be an idler or loose pulley, which is kept in position with collars (not shown) secured to the shaft. The speed of the loose pulley, in relation to the shaft will therefore, be twice that of the driving pulley, when pulleys are of the same diameter.

Metal Joints

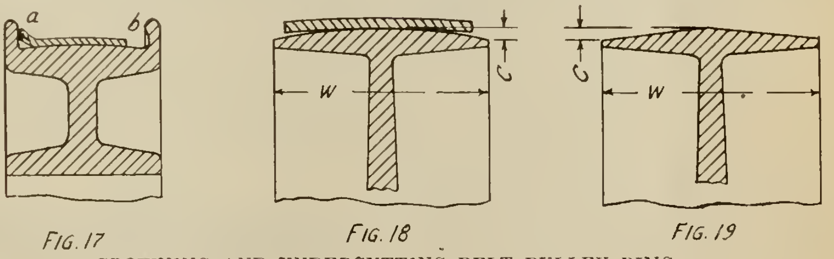
During the past few years many forms of metal joints and wire lacing have been designed and adopted; but while they may be highly recommended for certain purposes, they should not be used where necessity arises to shift a belt by hand. Experience has shown that joints of this description, after becoming somewhat worn will allow the metal or frayed wire, and often the raw hide pin, to protrude as shown at c and d, Fig. 11; this condition sometimes proving injurious to the machine operator.

A common cause of belt trouble is that shown in Fig. 12, where a wooden pulley hangs crooked on the shaft, owing to one side being tightened up more than the other. This fault should be remedied as early as possible.

Belt Guides

Where belts acquire a habit of continually slipping off on one side of a pulley, when taking up a load, it is a common practice to put up a temporary guide, in the shape of a stick nailed to a joist, as shown at (a) Fig. 15. This in many instances proves to be a permanent fixture, which in time will materially affect the life of the belt as the constant friction will ultimately fray or curl the edge. If it seems necessary to construct a guide for this purpose the method shown at (b) is suggested. This is a roller running on a rod, which is secured to the beam above. By this means the friction is considerably reduced by the rolling action; and the effect on the belt is less harmful.

While contrivances of this nature reduce the trouble of belts slipping off to a large extent, the general adoption of such methods should not be encouraged, as the advantages derived are not sufficient to counteract the loss sustained through belt depreciation.



CROWNING AND UNDERCUTTING BELT PULLEY RIMS.

The source of the trouble should be located as early as possible, and steps taken to eliminate it. This will likely be traced to shafts out of line, too great or insufficient crown, pulleys out of line, faulty belts, etc., or a combination of one or more of the above.

Balancing of Pulleys

When shafting is running at high speed, more attention is required in the balancing of pulleys. This, at first sight, seems a question of minor importance, but if the speed is excessive and the pulley of fairly large diameter, any irregularity in the mass of the metal will have a corresponding effect upon the shafts and bearings. The centrifugal force of the revolving pulley will cause the heavy section (a) Fig. 14, to swing farther from the centre of motion. This action can be more clearly illustrated by referring to the lower sketch, where the unbalanced weight is represented by a ball on a cord. By revolving the cord x-y at high speed, the centrifugal force set up will cause the cord x-y to be distorted from a straight line; the position taken up being represented by the dotted line. This lack of balance is often the cause of "sprung" shafts. It is therefore necessary, that high speed pulleys be properly balanced before being placed on the shaft. The most frequent method of balancing fly-wheels or pulleys is with the horizontal straight edge. This is very satisfactory where the speed is below the average; but when the speed is great, this method may not be reliable. For instance, a pulley may be found to be out of balance from excessive metal at the lower or hub end of one of the arms; metal is applied by the welding process to the rim end of the opposite arm, sufficient to show perfect balance on the straight edges. When the pulley is placed on the revolving shaft the speed will cause the pulley to be out of balance, but in the opposite direction to the original test. This is owing to the added metal being placed at a greater distance from the centre of motion.

When pulleys with curved arms are being used it is always advisable to have the curve face in the direction of the pull as shown in Fig. 13, so that the metal in the arms will be under compression. This method increases the limit of power which the pulley can transmit,

Belt Shifter Trouble

Trouble is often experienced from a belt creeping from the loose to the tight pulley of the machine counter-shaft. The source of this annoyance is usually found in the belt shifting apparatus. In Fig. 16 is shown a partial front and two side views of a belt shifting arrangement. If the shifting lever (a) travels much past the centre line of action x-y, the force of gravity will tend to bring the stick back to a vertical position, especially if the parts move freely.

To overcome this trouble the connections should be sufficiently tightened to avoid free movement, and where possible the distances A and B should be so proportioned that the movement (y) is no greater than what is necessary.

When placing the forks on the shift rod they should be secured in the position shown in (b) Fig. 16, at right angle to the travel of the belt. If secured at an angle, as shown at (c), the force exerted to move the belt will cause the edges of the belt to curl up as they come in contact with the inclined fork.

Crowning and Undercutting

The trouble met with in cases such as that of Fig. 15, may be also experienced with cone or flanged pulleys.

In Fig. 17 is shown a small flanged pulley with the belt climbing the face of the flange (a). This may be due to the causes previously mentioned or from an accumulation of dirt or belt dressing on the inner face of the flange. These flanges, and also the faces of cone pulleys should be undercut as shown at (b). When this is done the belt is only in contact at the edges where it enters and leaves the pulley.

Where belts are constantly run in the one position, it is advisable to crown the face of the pulley, as a belt under normal conditions will always run to the high point, and if this point is in the middle of the face the belt will retain a centre position on the pulley. However, there is a limit to the advantages derived from this process, for, if the convexity is too great the lack of flexibility in the belt will materially affect the contact on the face of the pulley, as shown in Fig. 18. The general rule for the crowning of pulleys is about ¼ inch to the foot of width, or $C = \frac{W}{48}$. This crown should have the shape of the section of a sphere as in Fig. 18, but in some cases two frustums of cones are formed as shown in Fig. 19.

It might be said in conclusion, that too much attention cannot be given to the proper care of belts and pulleys, as the efficient operation is often seriously affected by careless and inexperienced handling of this part of machine shop equipment.

NEW TYPE WORM GEARING

TO obtain a more perfect contact between the thread of the worm and the teeth of the worm wheel and increased load carrying capacity between the two gears, Percy Brown, of Park Gear Works, Huddersfield, in conjunction with F. J. Bostock, has designed and patented the arrangement shown in Figs. 1-3, the former being an elevation of the worm; Fig. 2 a similar elevation of the worm partly in section and of a fragment of a worm wheel in mesh therewith, the worm wheel being in section taken midway across the width of the teeth; and Fig. 3 an end elevation of the worm.

The invention consists in providing the thread of the worm with a surface every part of which contains a straight line passing from the root to the crest thereof and forming an oblique tangent to a cylinder along a helical line of contact at a constant angle, as indicated on each side of the worm thread by the dotted lines A and B in Figs. 1 and 3. The cylinder may be that of the worm at the base of the thread or may be of smaller or larger diameter. The teeth of the worm wheel C at a point midway across the width of the teeth are in cross-section formed with substantially straight side or surfaces D at the desired angles, as shown at Fig. 2. The thread of the worm shaped as above set forth admits of a more perfect contact being obtained between the thread of the worm and the teeth of the worm wheel, because when such a tooth shape is in working contact with a wheel whose tooth sides are substantially straight in medial section, these two shapes very closely approximate each other; hence when a load is applied, the elasticity of the metal provides for a contact of greater area than is ordinarily obtainable, and consequently gives an increased load carrying capacity between the two gears.

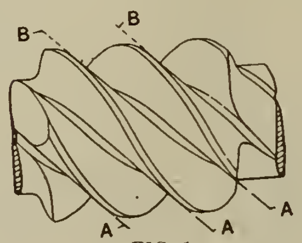


FIG. 1.

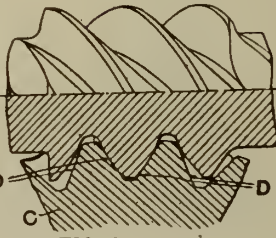


FIG. 2.

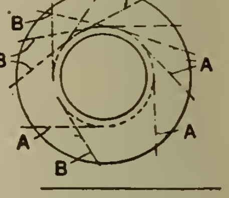


FIG. 3.

RELATIVE EFFICIENCY OF ROLLER AND BALL BEARINGS

AS the result of tests recently carried out at the University of Wisconsin to ascertain the relative efficiency of white metal, roller and ball bearings, it was found that in all cases the power per bearing—measured in watts—diminished with temperature up to about 100° Fah., after which there was a tendency for it to become constant.

There was a considerable increase of power required in respect of speed. Thus, at 80° Fah., with a 730-lb. load, and for white metal, the power was 13 watts at 150 revolutions, 30 watts at 250 revolutions, 48 watts at 350 revolutions, and 74 watts at 450 revolutions. The corresponding figures for roller bearings were 10, 19, 28 and 40 watts, and for ball bearings, 3, 7, 10, and 18 watts.

The co-efficient of friction followed approximately the temperature law. For white metal bearings the co-efficient was 0.005 to 0.015; for roller bearings 0.004 to 0.011; and for ball bearings 0.0015 to 0.003.

Breakdown tests were made by increasing the load until there was a sudden rise of temperature, with the following results:—White metal, 4,250 lb. per bearing; roller bearings, 5,100; and ball bearings, 4,650 lb.

MANUFACTURE OF RUBBER BELTING

IN a paper read before the Manchester Association of Engineers on March 11 by James Tinto, the author described the process of manufacture adopted in connection with rubber belting. In the first place, the cotton duck as it comes from the weavers is thoroughly dried by passing it through a cylindrical drying machine. It is then coiled up and taken to a rubber friction calender, where the friction or "rubber dough" is fed on to the duck and is passed through heavy calender rollers, so that the duck is thoroughly coated with the rubber.

The next process is the cutting up of the cloth into various widths according to the size and ply of the belts required; it then passes on to the making-up tables for lining-off and folding to the width and length. After this operation the whole belt must be carefully and thoroughly rollered with the object of driving out all air from between the plies to prevent "blistering" in the process of vulcanizing. The outer rubber cover is then applied according to the thickness required, and the rolling process has to be gone through again.

Vulcanizing

The belt is next taken to a large hydraulic press, where it is placed between two steam-heated chests and vulcanized at a temperature of not less than 280 deg. Fah. The belt is then ready for trimming, finishing and coiling. After vulcanizing there is a thin overflow of the rubber covering, which has to be trimmed off the edges of the belt being ground with fine emery cloth, after which it is passed through the coiling machine and completed. The hydraulic presses used for this class of work are usually designed to give a pressure of not less than 200 lb. per square inch, and such presses are at work, 30 ft. long by 6 ft. wide.

They have thirty 12-in. rams, arranged in pairs, and working at 1,500 lb. pressure per square inch. The bottom steam chest is movable, with the rams underneath, so that the whole can be lowered by gravity. The author remarked that conveyor belts for all heavy minerals, such as iron, gold ore, coal, etc., should have a covering of rubber not less than 3-16 in. thick.

Balata Belting

With regard to balata belting, the author said that its chief advantages were freedom from shrinkage, resistance to stretch, great tractive power, solidity of texture, great durability, absolute uniformity, and waterproofness. The balata belt had, he said, one great weakness, namely, its inability to stand heat, and for this reason it should not be exposed to temperatures of more than 100 deg. Fah., nor should it be allowed to come in contact with oils, both of which had an injurious effect on the gutta-percha-like nature of the balata.

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POWER ABSORBED BY SHAFTING

IN the course of a paper on "Modernization of Power Plant in Factories," read before the Junior Institution of Engineers, W. A. Tookey said that during recent years he has had a number of opportunities of determining the amount of power absorbed by shafting and belts in factories, and it will be seen from the list given in the accompanying table, taken indiscriminately from his records, that in many instances the proportion of power thus accounted for of the normal output from the engines concerned is extremely high.

Power Absorbed by Shafting in Small Factories

This is not remarkable, having regard to the conditions which obtain in the majority of factories when the shafting is erected as cheaply as possible, of as light a character as will just do the work, and supported on bearings at wide intervals, which in their turn are often bolted to insubstantial structures. Pulleys are frequently as small as parsimony dictates, so that with heavily-stressed belts anything like ideal efficiency cannot be approached. It will be evident that the dust rising from grinding and woodworking plants greatly increases the proportionate "shafting loads."

There is probably no need to remind engineers of the circumstances under which shafting and belts operate, says Vulcan. From the time that the shop starts work in the morning until the engine is shut down at night there is no opportunity of doing much to the shafting in the way of adjustment, however badly it may require it, while it is only in cases of breakdown, actual or imminent, that any attention is, in fact, given to it.

		Engine Power			Percentage on Col.	
Test No.	Factory	Normal b.h.p. A	Max. b.h.p. B	Shafting and belt friction	A	B
1	Woodworking	7.3	25.0	1.0	13.7	4.0
2	Leather tannery	7.5	28.0	2.5	33.3	9.0
3	Asbestos products	38.0	47.0	15.5	40.0	33.0*
4	Woodworking	9.5	24.0	8.5	90.0	35.5
5	Woodworking	8.5	8.7	8.5	100.0	100.0†
6	Chaff cutting	...	4.75	0.4	....	8.5
7	Leather glazing	7.0	18.7	1.0	14.3	5.3
8	Printing	1.7	6.5	1.0	59.0	15.4
9	Baking	...	11.5	1.0	....	8.7
10	Chaff cutting	...	7.3	1.3	....	17.8
11	Grinding	41.0	41.0	24.5	60.0	60.0
12	Refrigerating	6.7	17.4	3.6	54.0	20.7
13	Paint mixing	...	18.0	2.0	....	11.0
14	Woodworking	...	12.0	2.5	....	21.0
15	Grinding	1.5	7.5	0.7	47.0	9.3
16	Grinding	55.0	70.0	30.0	54.0	43.0
17	Leather fleshing	12.0	30.7	5.5	45.8	17.9
18	Grinding	24.0	....	10.25	43.0	....
19	Ink grinding	14.5	25.0	2.0	13.8	8.0
20	Woodworking	10.0	23.0	5.0	50.0	21.6
21	Ironfounding	36.0	52.0	15.0	42.0	29.0
22	Woodworking	14.0	....	4.2	30.0	....
23	Woodworking	19.5	40.0	7.5	38.7	18.8
24	Machine tools	84.0	138.0	23.0	27.5	16.7
25	Machine tools	21 kw	90.0	11.0	35.0	12.2‡
26	Woodworking	30.5	38.0	10.5	34.5	27.6
27	Woodworking	26.6	34.5	13.0	49.0	37.5
28	Woodworking	14.5	20.0	3.5	24.0	17.5

*Four floors.

†Insubstantial supporting structure. A second engine coped with the "load," while this dealt with the shafting friction.

‡Electrical transmission and shafting.

Mr. Tookey said he had seen bearings that had been worn through the bottom brass; very long shafts of small diameter receiving the power from an engine at one end, and giving power at its other extremity to some heavy machine; couplings fitted to shafts in the centre of wide spans; and large pulleys carrying highly-stressed belts to machines 2 ft. or 3 ft., and sometimes more, from the nearest bearing. He had been able to count the speed of rotation of a shaft by noting the periodicity of its dog-legged-ness, and had seen many instances of vibration being set up by a shaft fitted with unbalanced pulleys revolved at high speed.

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CONCRETE FLOORS FOR WORKSHOPS

CONCRETE makes a cheap floor for a workshop, but in many cases its efficiency is often spoiled through its getting cracked after some little time, and eventually more or less broken up. As the cause of this is not generally understood, the following remarks by B. Davis, H.M. Inspector of Factories for the Kent district, may be of interest. He remarks that in addition to the obvious reasons that builders often use too much sand in proportion to the cement, and have an insufficient thickness on bad foundations, there are others due to ignorance when the intention is good. Mixtures of sand and cement expand when they are wet, and contract as they dry, and within limits the greater the proportion of cement the greater the expansion and contraction.

A common practice is to put down a first layer of material with a small proportion of cement, to let this dry, and then put on top of it a thin layer with a large proportion of cement. This top part thus remains a separate layer instead of bonding with the lower part, as it would have done had it been put on at once on the still unset lower portion, while, being richer in cement, it expands and contracts more than the lower part, with the result that it may be rapidly broken up. For large surfaces, however good the workmanship and material, the expansion and contraction are almost certain to produce cracking unless the job is divided up vertically into sections with thin strips of wood between them.

◆

RAW MATERIAL FOR THE ENEMY

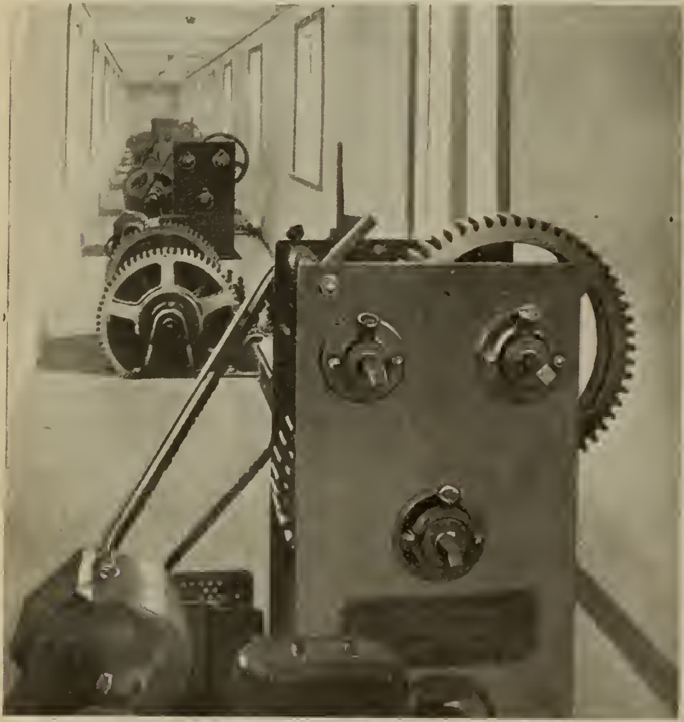
WE read in 'La Revue Electrique' that the French Minister of Commerce and Industry has forwarded to the French Chambers of Commerce, information to the effect that Germany and Austria-Hungary are now busy in accumulating in the United States stocks of material of prime necessity, since, when peace is declared, there will be a considerable demand for these goods and the prices ruling will be very high. The stocks are to be warehoused until the close of hostilities. They include, it is stated, wool, lard, fats, copper, tin, crude rubber, rubber air-tubes, cotton, oil, soap, tissues. The Minister adds that he has thought fit to transmit the information to the Chambers in order that the French commercial and industrial firms may take the necessary measures to cover themselves against a possible cornering of the products in question.

Electricity and Hydraulics

BASSANO DAM

By Max McD.

THE construction of the huge Bassano dam across the Bow River, 83 miles east of Calgary, Alberta, by the Canadian Pacific Railway Company marks the completion of the largest concrete work in Canada. As a result of its opening, a million acres of prairie land previously looked upon as of little or no use for agricultural purposes, is now placed under irrigation and is proving as productive as any other part of the Dominion. This gigantic work, which has entailed the expenditure of several millions of dollars, has been carried out by the Department of Natural Resources of the Canadian Pacific Railway Company. About four years have been spent on the project, the greatest part of which was the earthwork for the canals, aggregating twenty million cubic yards. Over a thousand small structures are scattered over the irrigable tract covering the greater part of 2,000 square miles.



POWER HOUSE AT THE C.P.R. BASSANO DAM.

The quantities, as shown by the records of the Dominion government, are notably large, the river receiving the drainage from over 5,000 square miles above Bassano. The Bow River has a heavy spring flow, the highest stages being reached between June 15th and August 15th, and thus furnishing an ample supply during the growing season. The low water surface is raised approximately 40 feet by the dam. It is a composite structure, the most notable portion being the concrete spillway, 720 ft. in length. This is built with regard to economy of material, and is of the "Ambursen" type, with heavy floor on the bed of the stream, protected by suitable cut-off walls. Upon this are concrete buttresses carrying a sloping deck with apron, the whole designed to pass 100,000 cubic feet of water per second with extreme height of 13 feet above the crest.

The concrete portion of the dam is prolonged westerly by a dyke with maximum height of 45 feet and length of 7000 feet, containing about 1,000,000 cubic yards. Extending easterly from the dam is the main canal, five miles in length, partly in a deep cut of 700 feet bottom width. Beyond the eastern end of this cut, the main canal, with a capacity of 3,800 cubic feet per second, divides, the smaller portion, with bed width of 30 feet and capacity of 800 cubic feet per second, turning toward the north, while the larger branch, with capacity of 2,200 second-feet, continues toward the east. On the northern branch and its sub-division are many important structures, such as drops and flumes, but the large number of these are on the eastern canal and its subdivisions.

The most notable of the canal structures is the Brooks aqueduct, 10,000 feet in length, with capacity of 900 second-feet, crossing a broad low depression. The design of this acqueduct is novel, but evidently based on careful study with a view to permanence and economy of material. All the larger structures are of concrete and the smaller ones which are built of wood, are, as occasion demands being replaced by concrete. The drops are also of concrete. In the aggregate, the structures connected with this irrigation project have more concrete than any other in the Dominion of Canada

* * *

HYDRAULIC PRESS RATING

CONSIDERABLE misunderstanding has occassionally arisen through the various methods of designating the power of hydraulic presses. This confusion has been more noticeable since the recent increase of multiple cylinder presses for use in making munitions. The power of a press, obviously is equal to the pressure per square inch, multiplied by the total number of square inches on which that pressure is exerted. It makes no difference whether the area on which the pressure acts is in one unit or in several, so long as they act simultaneously and are not opposed to each other. When one cylinder is opposite another, the pressure is not equal to the sum of the two cylinders as might be supposed, and in the case of a six-cylinder copper banding press as used in many plants just now, the effective pressure is the opposed to solid blocks. The pressure, while acting at six equidistant points, is evenly distributed around the circumference, and each cylinder is resisting the pressure of the cylinder opposite. To illustrate, Fig. 1 shows a sectional view through the centres of two opposite cylinders of a hydraulic press. When the spring A is completely compressed, the gauge registers 500 lbs. per sq. inch; this will be the pressure in all the hydraulic connections, from the pump to the cylinder chamber. With a diameter of 8.75 inches, the pressure on each of the two cylinders B and C, acting in the direction of the arrows will be 500 ×

$8.75^2 \times .7854 = 30{,}066$ lbs., or about 15 tons.

It might appear that this force of 15 tons acting on each piston exerts a pressure of 30 tons upon the spring, but in reality the force of 15 tons is only acting against a similar resistance from the opposite cylinder.

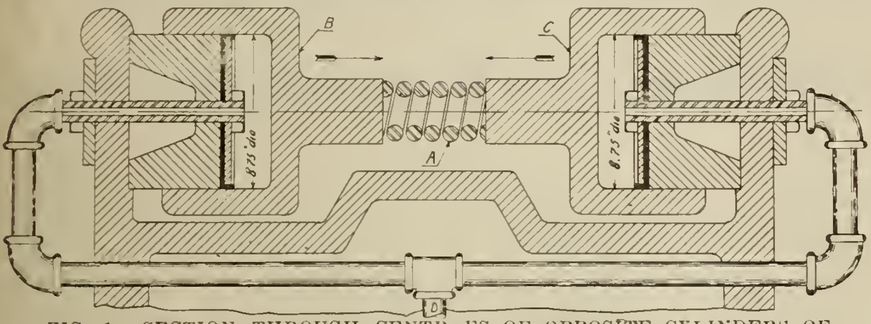


FIG. 1. SECTION THROUGH CENTRES OF OPPOSITE CYLINDERS OF HYDRAULIC PRESS.

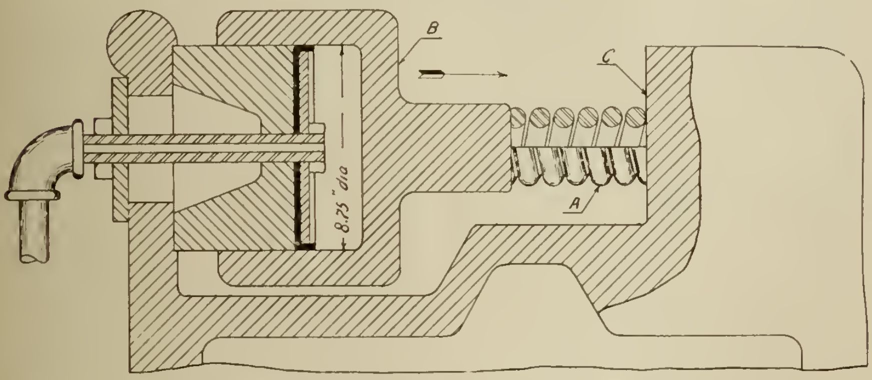


FIG. 2. SINGLE CYLINDER HYDRAULIC PRESS SECTION.

To further illustrate this principle, take the single cylinder hydraulic press shown in section in Fig. 2. It is quite evident that with a pressure of 500 lbs. per sq. in. showing on the gauge, the force acting in the direction of the arrow will be the same as that in Fig. 1, and the pressure on C, due to the action of the spring under compression will equal the diametrical opposed press shown in Fig. 1.—J.H.R.

BUYING AN ELECTRIC MOTOR

NOW that the demand for electric motors is so general, it often happens that an order has to be placed or a purchase effected by a person having little or no technical knowledge of electrical machinery. The non-technical buyer will much appreciate the hints which have been given by a well-known firm of machine tool makers for his guidance when making a selection of electric motors for works purposes.

It is of little importance whether the main frame of the motor is of iron or steel, but the feet should be planed, and laminated shoes fitted to the pole tips. The supports for the field coils should be so designed that the coils are firmly held, but at the same time there must be no sharp corners which would cut through the insulation by vibration. Obviously the shafts should be as stiff as possible, and oil throwers must be fitted to prevent any possibility of oil creeping along to the commutator and armature and affecting the insulation.

Ventilation should be provided in the armature so that the heat is evenly distributed, and this is usually obtained by means of ventilating ducts, both parallel and at right angles to the shaft. The armature cores are now all built up of laminated sheets insulated from each other, and having the conductors embedded in slots and held in position by strong steel bands, or in the case of large machines by wedges. It is desirable to have the commutators as large as possible in diameter in relation to the diameter of the armature, so that there are no bad bends in bringing the armature conductors into the commutator.

Armature Balancing

Very careful attention should be given to the balancing of the armature, particularly when the machine is required to be of the variable speed type for driving machine tools. Some buyers specify a certain radial wearing depth for the commutator sections. This radial wearing depth should not be too small, otherwise the commutator would need renewing at a comparatively early date, but on the other hand it is undesirable to specify too great a radial depth, as this puts up the cost of the machine unnecessarily. A good commutator will last as long as the machine, provided the machine is designed to run sparklessly.

The design of the bearings should not be niggardly, and it is very good practice to have two oil rings to each bearing, so that if by any chance one ring ceases to act the bearing is prevented from seizing. For ship-board use liberality in the design of the bearings is essential, and with two rings they should be so designed that during pitching or rolling at least one ring will be left free under any conditions to continue the lubrication. Most makers are now using the box type of brush gear, and it is a good feature to provide means of adjustment of the distance between the brush holders and the commutator, such that as the commutator wears down the same relation may be retained throughout.

Insulation

As regards insulation, the leading manufacturers now employ a special apparatus which exhausts all moisture from the insulator before forcing in under pressure the water-proofing varnish and, on general principles, a specified insulation resistance greater than one megohm should not be called for, as to obtain higher values a long baking at high temperatures may be required, which may permanently damage the insulating material. Breakdown tests should be applied, but in machines designed for moderate voltages a test pressure of three times the normal is sufficient.

The question of interpoles is one which is best left to the discretion of the manufacturers, but it can be taken for granted that, for variable speed motors, interpoles are necessary. In purchasing motors it must always be remembered that it is as essential to the manufacturer to know what his machine has to drive as it is for instance for the lathe maker to know what his customer requires the lathe to do.

* * *

Electrically-Heated Soaking Pits—Electrically-heated soaking pits for ingots, in place of the fuel-fired ones, are attracting interest in the steel world, says the Iron Age. Our contemporary gives a few figures concerning the electric soaking pits invented by T. F. Baily, president of the Electric Furnace Co., Alliance, Ohio, and adds that these can compete with gas-fired pits even where moderately hot stripping and charging is practised. The electric pit further has the advantage of a non-oxidizing atmosphere, which means a saving of from 1 to 2 per cent. of the weight of ingots put through the pit. It also takes only one-third the space occupied by a gas-fired pit of the same capacity. A feature of still greater importance is the elimination of surface defects in the ingots.

REFRIGERATION DEPARTMENT

DISTILLED AND RAW WATER ICE*

By C. W. Lamson.

YOU are no doubt more or less familiar with the ordinary type of steam-driven distilled water ice plant. The exhaust steam from the engines driving the ammonia compressor is condensed and utilized in filling the ice cans; that is to say, the ice is actually manufactured out of distilled water. Much trouble is experienced in eliminating the cylinder oil from the water. In order to extract this, reboilers are installed.

Why should it be necessary to use distilled water if good pure raw water can be obtained? Nature freezes raw water perfectly transparent. Why would it not freeze transparent in the can of an ice plant? It would if the time of freezing was extremely slow. However, an average 300-lb. cake of ice is frozen from 40 to 48 hours. Distilled water has been used for many years.

This system of making ice was used exclusively until about the year 1910, when ice experts began experimenting the manufacturing of raw water ice. The first plant was installed in Buffalo, N.Y., in 1912. Owing to its success practically all new plants which are being installed are using the raw water system, and many old distilled water plants are making the necessary changes for the manufacture of this type of ice.

Clear Raw Water Ice

In order to obtain clear raw water ice it was found necessary to keep the water in constant agitation. Many different methods have been employed, the use of air has met with most success, and is being employed universally at present. Of the various systems used, the drop pipe system is the favorite one at present. In this, a small pipe is dropped from the top into the centre of the can and is connected through a check valve to an air header which is connected with a blower supplying air at a pressure of approximately 4 pounds. In this way the air is blown into the bottom of the can, keeping the water in constant agitation. Of course, it is necessary to withdraw this pipe some time before the cake is completely frozen. After the pipe is withdrawn, the remaining water will freeze milky, but will be absolutely tasteless, providing pure water is used.

The advisability of installing a raw water plant depends chiefly upon the quality of water which can be obtained and the cost of power. Where coal is inexpensive and water is at hand in abundance, it might be advisable to operate a steam plant, condensing. Where oil is available at a nominal figure, it is sometimes advisable to operate with an oil engine. Where the central stations are offering a low rate for electric power it is most advisable to use this form of power owing to its simplicity of operation, reliability and low first cost.

Manufacturing Cost Comparisons

Less power is required in the manufacture of raw water ice owing to the fact that in a distilled water plant it is necessary to bring the temperature of the water down from boiling point, 212° to 32° before the freezing operation can be started. In a raw water plant the water is obtained from the city or other sources at an average temperature of about 50°, thus saving the energy required to bring the temperature of the water down from 212° to 50°. Also, water is a poor conductor of heat. The layer of water next to the can which freezes first, acts as an insulator. We all know that it takes much longer to freeze the centre of a cake of ice than it does the outside. This is due to this insulating quality of the water. In the raw water system the water is kept in constant agitation, thus destroying the insulating qualities of this layer of water.

* * *

EQUIPPING AND OPERATING ICE PLANTS.*

By A. C. Bishop.

THERE are many methods or systems of making ice, but there are only three kinds of ice plants. First, there is the plant that is always in trouble, periodically there is something wrong with it. Right in the hot weather the compressor is down and out.

Things go along all right for a week or so, and then the capacity falls off again, and the engineer tells you a propeller shaft is broken in the ice tank. You are so accustomed to disappointments that you say to yourself, "It might as well be the propeller shaft as anything else." Of course, you can't do anything with it now because you need the ice, even though you don't get quite so much of it. A few cool days come along and the plant picks up a little. You feel relieved and make yourself believe you are glad for the cool weather, but you are not.

No. 1 Plant

We haven't said anything about the engineer of this plant. You are an out-of-town ice man, of course, spending a day with your brother in the business; you no doubt met him at a convention or you would not have known him. You go out to the plant with him and you get nicely started through it when your friend is called to the office to answer the phone. You are left alone with the engineer and he immediately starts in. To begin with, he tells you that his boss, no matter how fine a fellow he might be socially, is a shyster to work for. While he is telling it to you, you can hardly hear him for steam sizzling out of leaky joints. You know that the compressors are ammonia compressors and not air compressors, by the smell in the engine-room, although there is as much air in the system as ammonia and you know without looking up that there is a water pipe overhead, as twice already a drop of water has hit you in the neck. He isn't man enough to quit the job so distasteful to him, but on the contrary has the nerve to accept a pay envelope every Saturday night.

I am not exaggerating when I say that there are many plants throughout the country like the one I have just described. My solution is to fire the engineer; you might miss him for a while, but you may land a better one. Keep on trying until you get one who does not know how to tell it, but on the contrary knows how to do it. You will know when he appears, as the plant will reflect his presence and one side of the ledger will know something has happened. You discharge the one for incompetency, therefore pay the other all the job will stand. Pay him liberally, for you will still be away ahead.

No. 2 Plant

The second kind of plant looks good and is seldom in difficulty. It makes a little more than the ice machine builder said it would, and does it quite regularly. There are two classes of engineer in this kind of plant. The first is harmless. He doesn't spend money changing the plant around every fifteen minutes, adding this to it and discarding other things. He doesn't change things because he doesn't know any better, this being the first ice plant he ever had anything to do with. His plant is kept up because he has always been an operating engineer of some kind. He is a mechanic and knows his business. He operates the plant as he found it, making the best of what he has.

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*From papers read before the New York, Pennsylvania and Ohio Ice Association convention at Erie, Pa.

The second type of engineer in a plant of this kind is a wise one, at least he thinks he is well informed. He makes good ice, a reasonable amount of it and fairly regular; but he doesn't do it with the original plant. Along comes Bill Jones selling an automatic regulator or appliance of some kind and the engineer listens to the scientific story about this particular apparatus and concludes that it is a good thing. You buy it because you know nothing about it, and you take your engineer's word for it. If you have suspicions that the thing won't earn you a nickel you sometimes buy it anyway because you are afriad to say "no." This kind of a plant looks like an evergreen tree on Christmas morning, trimmed up for fair. You say, "How am I to know when to say, 'Yes' and when to say No.' " Call in some one on the outside and get his opinion to help you decide. You go to others for legal opinion, why not do the same when you are about to spend a lot of money for improvements?

No. 3 Plant

Now, I come to the third kind of plant, that which is producing maximum results; the plant that is making everything possible with the machines installed, and the number of ice cans in the ice tank. We learn by comparison. If some one is making more ice than you are with a comparative plant, then you should do the same or know the reason why. If some one has a better fuel cost, analyze the conditions and bring your plant to do the same. You might have to make some minor changes in your plant, but usually they do not cost considerable. We do things a little different now than they did possibly when your plant was installed.

Initial Plant Installation

The principal thing, of course, is to build a plant right in the first place. A well-arranged plant utilizes every square foot of floor space advantageously. The smaller the building for a given capacity, the better the returns on the investment, for buildings cost money. Ammonia condensers should be of liberal surface to keep down the head pressure. If you have no wells, then the tower must be suitable to dissipate the heat. The ice tank, too, should be constructed just so. Uniform brine circulation is all important; the relative brine level on ice can to water in the can and many other things make for maximum efficiency. Maximum output is bound to mean cheaper ice, for the more ice you make with a given number of men and the same building and machinery, the cheaper will be the ice. If your fuel cost is high and you are firing by hand, put in a stoker. Stokers as a rule are a good investment. They usually pay for themselves in two or three years.

Raw Water Ice

I hear some one say, "I thought he would say something about raw water ice." The kind of a plant to instal is usually determined by local conditions. Right now we are building a distilled water plant and an electrically-driven raw water plant. In the first case, exhaust steam is available, and in the second case the plant will be located in a residential section where coal would not be permissible. I would like some day to build a steam-driven raw water plant; steam driven, as we now have exceedingly economical engines, and raw water ice, because there would not be enough exhaust steam available for distilled water ice.

A PUMP REPAIR

By Chas. H. Stephen.

LAST spring it became necessary to overhaul a 6 x 4 x 6-inch duplex steam pump of the solid plunger type, that we used for circulating calcium brine. The pump has been in constant use for twelve years to my knowledge, and needed new rods, as well as linings and plungers for the water end. In taking out the brass linings part of the casting of the cylinder walls came with them. Upon investigating, I discovered that the cast iron in the cylinders resembled graphite and could easily be scraped with an ordinary jack-knife. Having the new parts on hand, I was anxious to use them and get at least one more year's service out of the pump before consigning it to the scrap heap, and proceeded thus:

I cleaned and scraped inside of cylinders, and when I got through they were more octagonal than round. The new rods were then put in and packed tight to centre them, and the plungers screwed tight on the taper of rods. The pump was set vertical with water end up to facilitate putting in the linings, and also to help keep plungers centred. The outsides of the linings were then treated with a coat of "Smooth-on" iron cement mixed with water to the consistency of a medium putty, from one-eighth to one-fourth inch thick, slipped over the plungers, and driven down until the shoulder of the lining fitted against what remained of the casting that was originally bored and faced to receive it, and finally tightened with the binder.

Both cylinders received similar treatment and had ample time to set before pump was needed. The pump started out nicely and after about three months' service showed no distress. I would not say it runs like a new one, but it certainly makes a first-class old one, and I expect quite a little service from it yet. A couple of pounds of "Smooth-on" iron cement was the only additional cost.—Ice and Refrigeration.

THE COLD STORAGE OF FOOD PRODUCTS

MUCH useful information, especially for those who have a commercial interest in cold storage problems, is embodied in Bulletin No. 44 of the Dairy and Cold Storage series issued by the Department of Agriculture at Ottawa. It has been prepared by Commissioner Ruddick and Inspector Burgess, of the Dairy and Cold Storage Branch, with the intention of placing at their disposal information which will be helpful to a large number of the smaller establishments throughout the country which are in charge of men with limited experience.

In dealing with the prejudice against cold storage and cold stored foods, the authors state the average customer is not in a position to discriminate between defects which are actually due to long handling in cold storage and those which are the result of improper handling. Merchants often neglect to take advantage of cold storage facilities until their produce is beginning to spoil, but as a general rule articles of food are not kept long enough in cold storage to show serious deterioration if they have been in proper condition when placed therein.

Refrigeration of dairy products is considered under three heads; milk, butter, and cheese. Milk which is cooled immediately, say to 60 deg. Fahr., will keep longer and be in better condition than if it is allowed to remain at a temperature of 70 to 80 degrees for several hours and then cooled to 40. For practical purposes a temperature of 40 degs. F. is low enough for the preservation of milk, but even then its preservation can only be a matter of days under ordinary conditions.

Butter is an unstable product. Experiments and investigations have shown that perceptible changes eventually occur under any storage temperature, no matter how low and that the effect of storing at different temperatures is only a matter of degree and not of absolute stoppage of all change in any case.

Fruit and egg storage forms the subject of many practical hints, methods of wrapping, materials, problems of management, and sanitation being dealt with in the 24 pages of the publication.

Light, Heat and Ventilation

DATA RELATIVE TO HEATING AND HEATING SYSTEMS—II.

By T. W. Reynolds. *

As the water in a hot water heating system is heated from 40 degs. to 222 degs., it increases in bulk, the amount of expansion being approximately equal to one twenty-third of its volume. An expansion tank which has a capacity sufficient to easily accomodate the increase in bulk through a 200 deg. range of temperature, plus a safe margin to replace water lost through evaporation, leakage, repairs to the system, refilling, or otherwise, and to prevent the entry of air into the system should be placed on every hot water installation. (See Figures 2, 4, 6, and 7). It should be located two feet above the highest radiator and where the possibilities of freezing are remote. Flow and return connections are advisable when necessary to locate the tank in a cold unheated space.

The expansion tank may be constructed with a ball cock to automatically supply the water which is lost from the system. This is not advisable in a full size tank for the ball cock may rust tight and refuse to operate when required, the overflow occurring only at remote intervals. Too small a tank is not to be desired as constant overflow may cause freezing in severe weather, depending upon the tank location. The expansion tank should always be provided with an overflow pipe. This should be run on inside walls to protect it from freezing and to an open fixture in the basement, or directly to the outside. A suitable vent should always be provided on the overflow pipe to prevent it syphoning the water from the system. A direct and separate connection (usually a 1 in. pipe), from bottom of boiler to tank is best. However if connected to a riser serving a radiator on the top floor it should be from just below the radiator connection. Periodical visits to watch the water level in the expansion tank may be avoided by installing an altitude gauge connected direct to the boiler. A fixed hand on the dial is adjusted for the height of water line in the expansion tank when the system is first properly filled. The movable hand indicates from time to time any loss of water from the system due to evaporation or other causes.

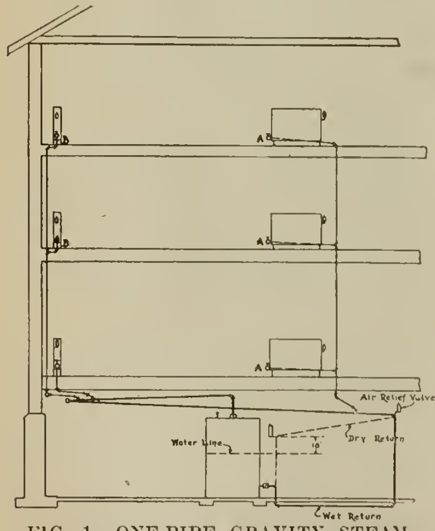

FIG. 1. ONE-PIPE GRAVITY STEAM SYSTEM.

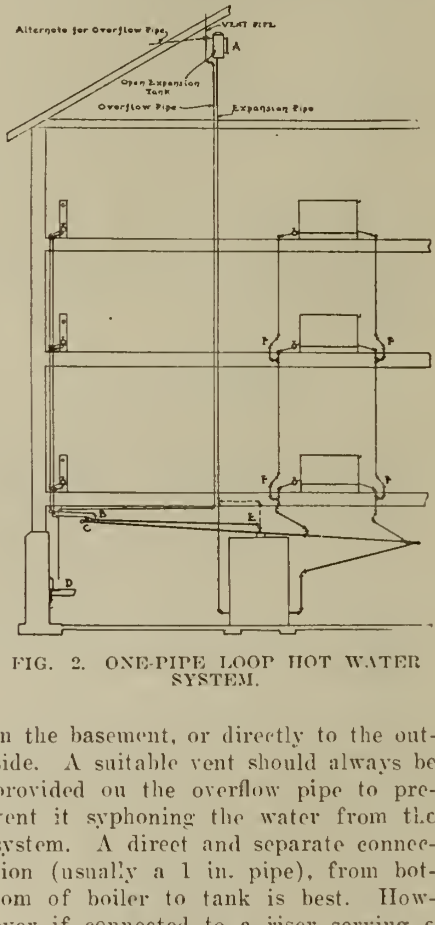

FIG. 2. ONE-PIPE LOOP HOT WATER SYSTEM.

Heating Systems

Systems of heating are usually designated both by the medium employed in carrying the heat, as hot air, steam and hot water, and by the arrangement of the piping. This combined nomenclature is illustrated in the following systems, all of which are in very general use:—The one or two-pipe or one-pipe overhead system of steam or hot water; the one or two-pipe mechanical vacuum steam system; the two-pipe self-induced vacuum steam system, and the two-pipe pressure hot water system.

The air systems may be gravity or pressure, either with single or multiple ducts, and the primary source of heat may be a furnace or steam or hot water in coils. Combination of air with steam or hot water systems are frequent .

In planning a low pressure steam apparatus, a warm air heating apparatus or a hot water method of heating, we may choose between several different systems, any of which, if properly erected, will give satisfactory results. Our choice should depend upon the special conditions and the requirements governing the plant under consideration, though individual preferences, peculiarity of local conditions, etc., may affect our decision.

One-pipe Steam System

The regular one-pipe steam heating system consists of a one-main supply carried to the ceiling over the boiler (see Fig. 1), then run at a slight pitch in the direction of the branches to be supplied. The main supply must at no point be less than eighteen inches (preferably higher) above the water line of the boiler, and should extend full size two feet beyond

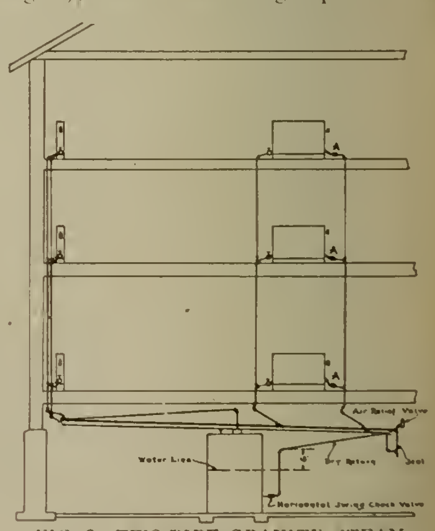

FIG. 3. TWO-PIPE GRAVITY STEAM SYSTEM.

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*MacMullen, Riley & Durley, Toronto.

the last connection taken off, from whence it may be carried back to the boiler either as a dry or as a wet return. If the main is ended at the last radiator connection, trouble will be experienced, due to the steam forcing water into the radiator.

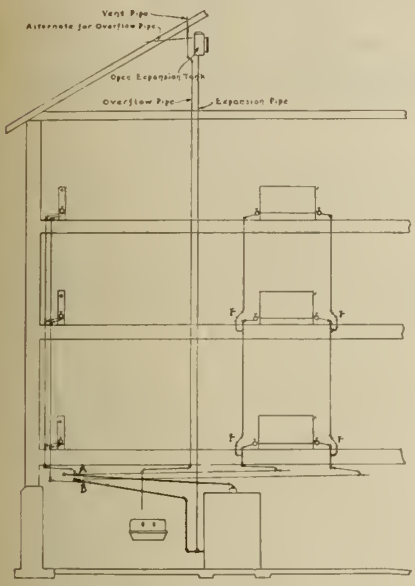

FIG. 4. TWO-PIPE OPEN TANK HOT WATER SYSTEM.

Branches are taken off from the main, one for each riser or first floor radiator, either on top or at an angle of 45 deg., and should slope upward from the main. If it becomes necessary to pitch the branch downward from the main, it must be relieved at the lowest point, and this relief pipe connected to the nearest return below the water line of the boiler. If the piping is arranged as a long circuit main, it may be necessary at some point in its run to step the main up to a higher elevation. In this event a drip should be provided at the base of the riser.

As the steam is conveyed to, and the condensation from, the radiators in the same branch and risers, it is necessary to use larger piping in the one-pipe method than is required in the two-pipe work (see Fig. 3). The condensation in the risers will flow downward, and will have a tendency to cling to the inside surface of the pipe, while the steam will travel upward inside this cylinder of water. In the horizontal pipes the steam flows along the top, while the water flows at the bottom of the pipe—each in an opposite direction. The end of the radiator admitting the steam should be lowest, so that the condensation will flow back freely, otherwise water hammer will result.

Overhead Piping or "Mills" System

The overhead piping method of heating is known as the "Mills" system, named after J. H. Mills, who first installed it in steam and hot water plants. Perkins in his design of high pressure hot water heating made use of this method, and Peclet mentions this practice as existing in France in 1830. Fig. 5 shows the system applied to a one-pipe steam installation. It is sometimes installed as a two-pipe job, and may have either a dry or a wet return. It is necessary to avoid pockets in the pipe lines where air may collect and prevent circulation .

In the "Mills" system one large riser is carried from the top of the boiler directly to the attic or ceiling of the top storey, from which, at point A (see Fig. 5), a distributing main is carried around the top of the building, always pitching away from point A in the direction of the down feed risers B. Air relief valve should always be placed at the top of each down feed riser as well as on each radiator unit .

This system is simple in construction and is very positive in the circulation of the heating medium. It can be used in almost any type of building, and may be readily converted into a hot water system (see Fig. 6), provided it is installed as a two-pipe plant. It is more particularly used where headroom is valuable, in the basement, or where the basement ceiling is so low that the steam main having but a short rise would lift water from the boiler, or where the steam main might through the necessity of maintaining the proper grade be below the water line of the boiler.

Fig. 6 shows an overhead system that may use either hot water or steam as a heating medium for transferring heat from the boiler to the rooms. The radiators on each floor when supplied with hot water maintain their own circulation due to their cooling effect. The water cooling descends, and because of its lower temperature, the amount of radiation on the lower floors must be increased to correspond to the decreased heat transmission per square foot of radiation.

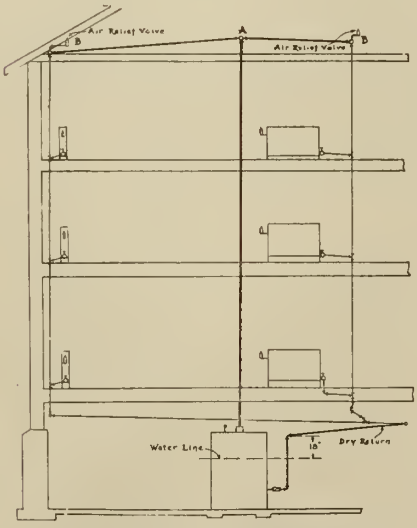

FIG. 5. GRAVITY STEAM ONE-PIPE OVERHEAD SYSTEM.

It is necessary to provide hot water radiation (in the plant described in Fig. 6) with an air relief valve at the top of each radiator unit. Such a radiator may be used for either steam or hot water, but a steam radiator cannot be used for hot water heating. A steam valve should be placed on the supply end and a check valve on the return end at E of the radiator. A steam radiator valve may replace the check valve, and it is better to have the supply to the radiator enter at a top opening, D. It is necessary to have a boiler fitted with steam trimmings. An expansion tank should be connected at the highest point, A, of the system, and a gate valve provided in the expansion line. The expansion tank is the safety valve of the system, and for this reason the gate valve should never be closed while using the installation as a hot water plant.

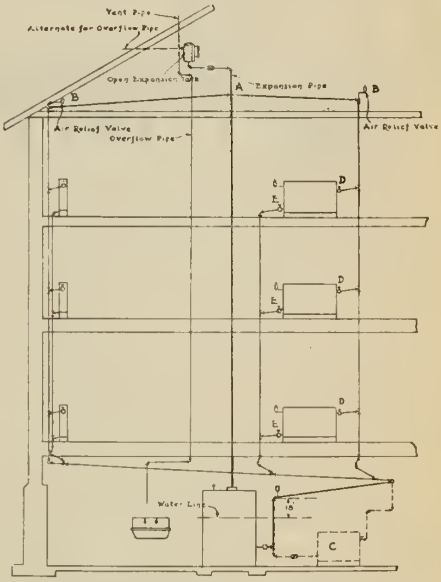

FIG. 6. COMBINED HOT WATER OPEN TANK AND STEAM OVERHEAD SYSTEM.

One special advantage that the overhead system has over others is the practicability of placing the radiators below the water line of the boiler (shown at C, Fig. 6), a wet return being used. Another advantage is that the steam and condensation both flow in the same direction, consequently the velocities are higher and pipe sizes may be somewhat reduced.

* * *

Welland, Ont.—The Business and Industrial Committee at a meeting held recently authorized Chairman George Clarke and Mayor Clendenning to negotiate with the Perfection Tire and Motor Co., which seeks to establish a branch plant in Canada.

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THE POWER HOUSE

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GENERAL BUSINESS CONDITIONS

A GRATIFYING feature of the present industrial situation is the steady improvement in domestic business, due to the prosperous condition of the country. The outlook for an increase in exports, other than munitions and war supplies, has improved considerably and manufacturers are looking for more important developments. The spring weather has had a stimulating effect on many industries and the outlook generally is distinctly favorable. Navigation will be open on the Lakes and St. Lawrence very shortly, which will considerably relieve the congestion of freight at railroad terminals. The situation in this regard has been getting more and more acute and has caused considerable delay to shipments and inconvenience to merchants. The customs returns for Toronto for the fiscal year which ended on March 31, are almost two million dollars in excess of the greatest previous year in the history of the port. There has been a very marked gain in revenue since September, and March showed the largest increase for any month.

Manufacturers are concerned over the shortage of labor which is beginning to be felt, and which will become more serious as the number of battalions for overseas increases. The shortage of raw materials is also becoming a serious question for manufacturers to contend with, in addition prices are still rising, thus increasing the cost of production. The upward trend in prices of finished products continues, a number of advances having been made during recent weeks.

EXPORT TRADE DEVELOPMENT

AN interesting feature relative to the development of American export trade, and incidentally that of the home market is the appeal by the United States Bureau of Foreign and Domestic Commerce for young, high-grade men whose education and natural ability fit them for service abroad. It is realized that nothing will contribute so effectively to the efficiency of the Bureau in the matter of aiding manufacturers to establish new connections and make those already formed more progressively valuable, than through the above indicated medium. As showing the urgency with which the immediate situation is viewed, and the highly sanguine achievement expectations formed of the scheme, it is desired that young men in large numbers present themselves at the Civil Service Examinations on April 5, the purposes of which are the selection of clerks for service with Commercial Attaches in foreign countries, and for service in the Bureau of Foreign and Domestic Commerce at home. The knowledge of one or more foreign languages is made an essential, and the salaries for appointments abroad are stated as being $1,500 per annum.

Canada, as well as the United States, is interested in establishing and building up an export trade. Her Attaches abroad—Trade Commissioners, are for the most part, however, located in Great Britain or in Colonies of the Empire, but the time has arrived when she too must "lengthen her cords and strengthen her stakes" by taking action along lines very similar to those of our Southern neighbors. Something more than the administrative and business activities of our Department of Trade and Commerce are called for at this juncture, and either in co-operation therewith or on their own initiative should our Canadian manufacturers in a corporate capacity take the requisite step. The scheme launched by the United States Bureau of Foreign and Domestic Commerce is worth appropriating.

NATIONAL FAIRS AND NATIONAL BUSINESS

THE Second British Industries Fair was held from Feb. 21 to Mar. 3 in the Victoria and Albert Museum, London, Eng. In drawing the attention of Canadian firms to this event, emphasis is laid on the object of these Fairs which are to be of annual occurrence and destined to be of great assistance in furthering British trade interests.

The object is to bring manufacturers into contact with buyers for the home and overseas markets, and thus assist the former to capture the trade in certain products previously supplied by Germany. The first Fair which was held a year ago was organized by the British Board of Trade, and the results were so satisfactory that the exhibitors urged that body to assume control of future functions.

The importance of such an event will be understood when it is stated that admission was by invitation of the Board of Trade only, and was confined to bona fide buyers for home and overseas markets, this restriction of admission emphasizing the fact that the Fair was organized for business pure and simple.

While we do not wish to appear as advocating anything like an abandonment of amusement at the Canadian National Exhibition, we do wish to point out the desirability of every Canadian manufacturer exhibiting his product more extensively and intensively than ever before. The Exhibition authorities can be relied upon to give the usual publicity to the event, and the Department of Trade and Commerce through their Commissioners should see that foreign buyers are advised of the event in time to include it in their itinerary.

The Canadian Exhibition, however, is broader in its scope than the British Fair referred to, which was confined to toys and games; earthenware, porcelain and china; glass goods; fancy goods; and stationery, etc., and the wider field here only makes it more desirable that every line of industry be represented more strongly than before. The value of the efforts being made by the Department of Trade and Commerce on behalf of our manufacturers could be admirably demonstrated by the establishment of a Bureau at the Exhibition where samples and catalogues at present in Ottawa would be available to interested parties. The opportunity for examining these articles would be welcomed and accepted by numerous parties who otherwise might not be able to make a special journey to Ottawa, and the present awakening of Canadian interest in overseas trade would receive an impetus which will be invaluable during the world-wide competition of the near future.

The Operators' Point of View

HEATING FEED WATER-ENGINE CONDENSING

By J. M.

REFERRING to plan No. 2, Column 1, page 39 of the February issue of The Power House, I should mention that when using an open feed water heater into which pump and other auxiliaries are piped, it is also necessary to remove the oil from these. A heater equipped with an oil separator should therefore be selected and all exhausts piped through it in the first instance. By making this selection the expense of fitting a separator later is avoided.

For saw, planing and other mills in the country and in smaller towns where an open heater cannot be furnished with water from the town supply mains, an additional pump is necessary to put water into the heater and as it works against the lift and atmospheric pressure only, a suction pump of suitable size and operated by a pump jack is sufficient. The boiler feed pump works between the heater and the boiler and should receive the heated water by gravity. With a closed heater the latter is between the feed pump and the boiler.

Mention of these two points is not meant as a kick at the open heater. It has compensating advantages such as passing B.t.us. to the water direct instead of through tubes and perhaps scale and it also returns the condensed steam to the feed pump instead of to waste, but if not spoken of these items might easily I think, be forgotten or overlooked by someone about to install their first equipment of the kind and wishing of course to choose the make best suited to their particular plant.

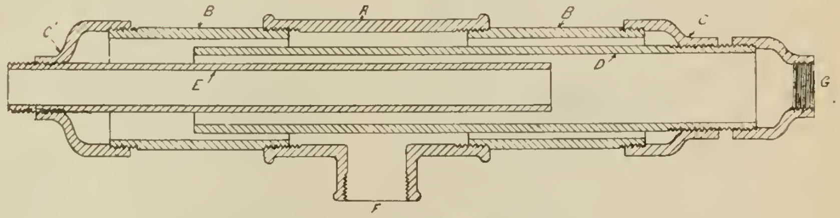
* * *

HOW ABOUT A SHOWER BATH?

By J. E. Noble.

THE accompanying sketch shows a design of water mixer I have constructed for use in connection with the mixing of water for shower baths. Satisfactory results have been obtained by its use, as it eliminates the sudden spurts of cold or hot water which usually occur when no mixer is used.

The device consists of a 2 in. x 1 in. tee A, to which is connected two suitable nipples, B and B^1. To the latter nipple is secured a 2 in. x 1¼ in. coupling C, which is tapped as shown, so that the pipe D, which has a suitable length of parallel thread, may be screwed through from the inside as shown. The opposite end of the mixer is constructed along similar lines, with the exception, however, that the coupling C is of a different size, being 2 in. x ¾ in., and to this the length of pipe E is fitted in the manner shown.



HOT WATER MIXER FOR SHOWER BATHS.

Hot water is admitted into the mixer at H and cold water at G and after being properly mixed and regulated to the desired temperature, is drawn off at F.

* * *

REGARDING BELT TROUBLE ON GRINDER

By J. M.

REPLYING to Mr. Cottam (page 62 of Feb. Power House), I figure that with his engine running 290 r.p.m., his countershaft runs 580 and grinder runs 3,712 r.p.m. His engine belt travels 3,038 ft. per min., and his grinder belt travels 7,290 ft. per min., which is excessive, being at the rate of one mile in forty-four seconds or over four miles in three minutes. I would consider 2,500 r.p.m. a more desirable speed as this would give just under 5,000 ft. per min. belt speed, and this is plenty fast for economical belt service. Swift running belts sometimes flop owing to a tendency to entrap air between the belt and the pulley and the remedy is to punch holes a few inches apart in the belt, this lets the air escape thus giving better belt contact, but owing to the dimensions of the small pulley and width of belt required I do not think entrapped air is the trouble in this case, especially as I judge, from his remarks, that the belt runs true on the large pulley.

It reminds me of grinder belt troubles I witnessed some years ago where a small grinder having a 6 x 6 pulley was installed and driven from an additional pulley placed on the engine shaft. The manufacturers had shipped a five-inch belt with the machine and as it is good practice to have the pulley 20 per cent. wider than the belt used this looked all right and possibly with a proper amount of suitable belt dressing might have carried the load fairly well, but rubber belts throughout the mill all gave good service without dressing so none was kept on hand and to make this belt do the work untreated it was necessary to make it very tight, and then the lacing would soon break. After two or three days of this the 5 in. belt was replaced by a 6 in. belt, also rubber, but it too had to be made tight to carry the load without dressing. After running awhile, it would begin to run from side to side on both pulleys.

This was due to lacing with laces cut from hide thin on one edge thus making the laces thin on one end: and as they were only partially stretched before use they had to stretch afterwards and did so more at the thin end than at the other and since the belt was naturally laced with thinner lace at one edge than at the other a crooked joint and a wobble was the result. When laced again with well stretched lace it would run all right until a thin portion of the lace broke and the joint would go crooked again. Lacing with well stretched laces of uniform width, thickness, and texture throughout remedied these things but there came a time when the belt would run badly from side to side on the small pulley, as I understand Mr. Cottam's belt to be doing.

It looked as though the belt slipped a little and started to run off to one side, then gripped again and came back onto the pulley, repeating this cycle rapidly. The grinder frame oscillatory motion which, though really the cause of the trouble, was assumed to be proof that the belt really was alternately slipping and jerking instead of pulling steadily and so the belt was tightened more and the operator, taking advantage of the increased cohesion, crowded the grinder more. The frame ceased to oscillate but the belt ran over to one side of the pulley and stayed there. When adjustments were made that brought it true with this load on it was found that the belt ran over to the other side of the pulley if it became slack again.

The oscillation of the machine was the result of looseness developing in the joints where the legs were bolted to the frame above and to the skids below. Had the frame been of rectangular construction probably but little inconvenience would have been experienced since the axis of oscillation would have been at right angles to the line of the belt thus keeping the arbor always level and permitting each end to pull forward an equal amount, but as the grinder legs were a little more than twice as far apart at one end of the machine as they were at the other (in fact the machine virtually rested on three supports since the legs at the narrow end were both included in one casting), this put the axis of oscillation on an angle of over 22 degrees to the belt. When running idle the machine was held down by its own weight and the belt ran true, but with load on the belt the far side of the frame lifted a little and, owing to the above mentioned angle of oscillation, one end of the arbor raised more, and came forward more than the other end did thus throwing it out of level and out of line and drawing the belt aside.

When the belt was slack enough to permit the machine dropping back a little the arbor came nearer level and the belt started back onto the pulley again, wavering back and forth according as the far side of the frame rose or fell. When the belt was made tight enough to hold the machine up tight continually the oscillation ceased but the arbor was out of line and it did not require much of a lift to throw the short arbor out of line an amount equal to two or three inches in twenty feet, which is considerable. Had the machine been heavier this oscillation would probably only have occurred when the belt was tightest and working hardest, it being then impossible to get the belt tight enough to hold up the machine indefinitely and prevent the oscillation in that way.

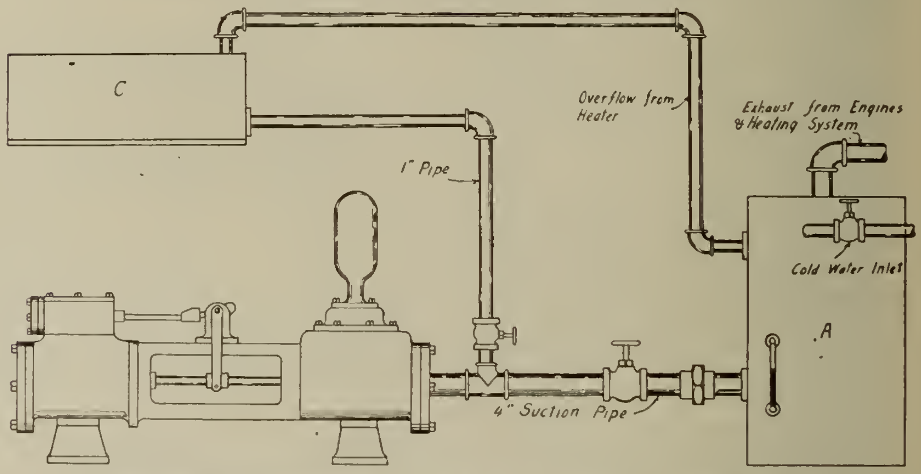
It is perhaps only fair to the operator to mention that the machine sat upon a platform supported by posts and braced from one floor only and that the vibration of this platform detracted the operator's attention from, and also helped to conceal the independent, trouble making oscillation of the grinder itself until it had developed sufficiently to effect the running of the belt as above described.

Crowding the machine also caused rapid wear of the end thrust bearing, causing heating and frequent renewing of the ball bearings and it finally became the habit to run the machine at a capacity which did not overtax it, thus grinding less in an hour, but losing fewer hours, paying out less for repairs and avoiding worry and vexation of spirit, though being run from the mill engine as an aside the respective fuel requirements of each method were un-determined.

LICENSE LAWS FOR STATIONARY ENGINEERS

By W. A. Foster

REGARDING the article on the above subject in The Power House for March, I wish to say that I too, have worked with some stationary engineers, and if you can see through the rough sketch which I have made, you will form your own idea of one of them; A is a water heater in which cold water is admitted through a 1 in. pipe from city supply, B is boiler feed pump, C is overflow tank, merely a wooden box 6 ft. x 4 ft. x 2 ft., into which overflow from heater ran. A 1 in. pipe connects box to suction of pump.



ILLUSTRATING ARRANGEMENT OF WATER HEATER, OVERFLOW TANK AND SUCTION PIPE.

The idea of this arrangement is to open the 1 in. valve and partly close the 4 in. valve so as to take water out of the box. This box is directly behind the boilers, and when tubes are blown it gets full of soot. The party gets very dirty boilers and his pump won't work right. Is a man who does this sort of thing entitled to be known as an engineer?

QUERIES

THROUGH the columns of your valuable paper I would like to ask Mr. R. McLaren for his authority for the statement he made in February's number of The Power House (in an article re License Laws for Engineers) that "Watt had no shop experience." Also what, in his opinion was Jas. Watt doing from the year 1755 to 1764?—Maurice F. Scott.

* * *

VERY recently I was puzzled over the size of a centrifugal pump, and now apply for information through the columns of The Power House. Given the diameter of impeller, revs per min., and head; how much water would pump throw per min.? or given the amount of water, and head, what size of pump would be required?

I have looked through the books I have for a formulae on this question, but have been unable to find one.

Clipper Clippings for March has been distributed by the Clipper Belt Lacer Co., Grand Rapids, Mich. This number deals principally with the manufacture of canvas belts and a few notes on the Stewart-Warner Corporation plant where a number of Clipper lacers are used.

"SIR FUSIBLE PLUG"

By N. G. Near

A plug we'll call Sir Fusible,
Disguised is Sir Amusible.
Sometimes it melts and then ag'in
It won't if it is not pure tin.

When lead and zinc are added too
There's danger that you'll melt your
flue.
At sixteen hundred Centrigrade
Your boiler may become "unmade."

They say poor tin doth change its tune
It oxidizes, and right soon
Becomes plain Ess Enn Oh Two,
(SnO_2)
And when it does, why, good bye flue.

So, summing up, they frankly say
That pure tin is the proper way.
At Centigrade two thirty five
It melts, and lo, we're still alive.

Operators' Instruction Course

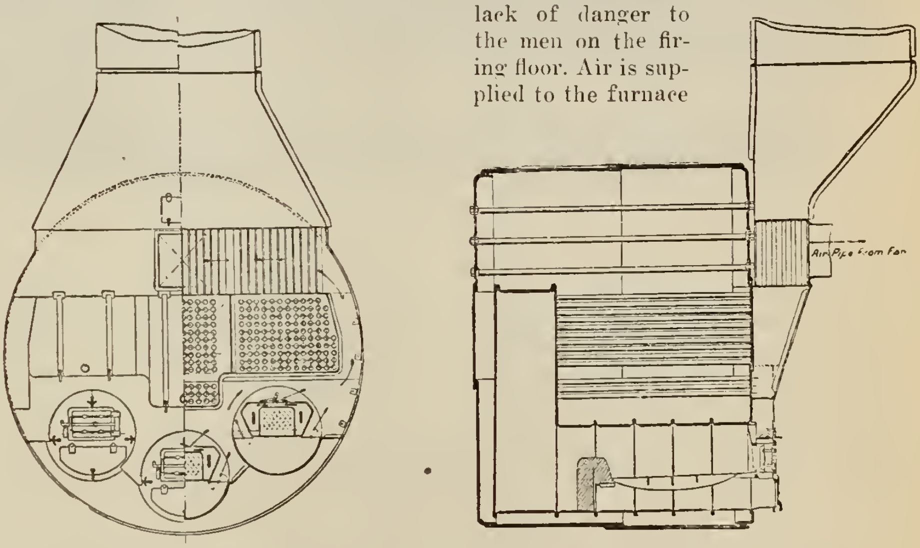
THE STEAM BOILER—IV.

TO burn ordinary coal or coke requires on an average about 12 pounds of air, but to provide for the dilution of the gaseous products so that the air has free access to the fuel, some 24 pounds of air per pound of fuel is the practical experience. The amount of coal burned per square foot of grate area depends on two things—the constituent of the coal and the draft. Experience with anthracite as against bituminous coal, and with weather influence on any natural draft equipment bears out the above assertion.

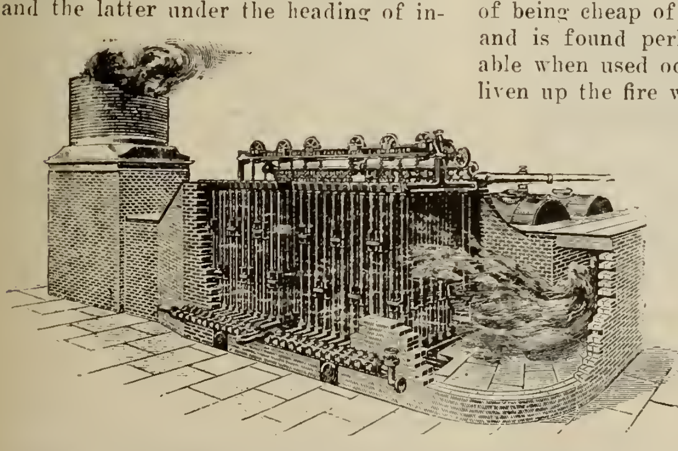
Artificial Draft

Natural draft, as we have already seen, is that secured through the medium of the stack, and is that most common to stationary power plant installations. Under certain circumstances, however, artificial draft has to be resorted to, and, in principle, it is of two distinct types—forced and induced. When for any reason, and there are many such, the steaming capacity of a boiler is restricted, at least to meet abnormal or special requirements on more or less yet intermittent occasions, it becomes absolutely necessary that artificial draft equipment of one sort or another form part of the boiler installation. There are four commonly adopted methods of producing artificial draft, the first three of which come under the heading of forced draft, and the latter under the heading of induced draft. They are dealt with in the following paragraphs:

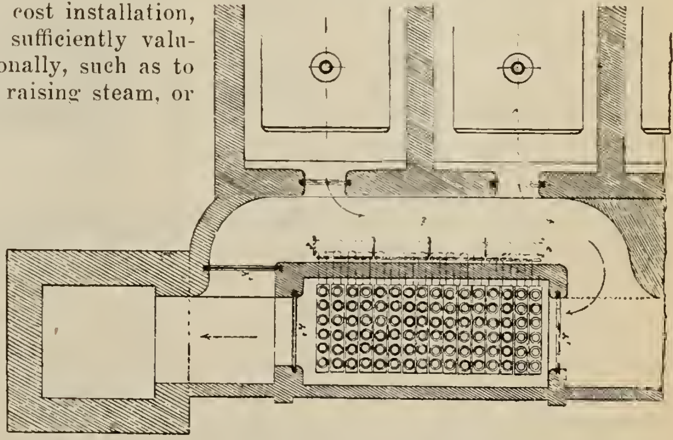
(1)—The steam blast, by application of which the products of combustion leave the stack at a high velocity, the exhaust from a locomotive being a typical example. Live steam is used, however, in many cases. The steam blast, although bearing at one and the same time the stamp of antiquity and up-to-dateness in many respects, is neither very effective nor economical, there being losses in both coal and feed water—the latter, of course, particularly when live steam is used. With the blast pipe inserted in and about the base of a steel plate stack, the latter wears out unduly fast. The steam blast has the advantage of being cheap of first cost installation, and is found perhaps sufficiently valuable when used occasionally, such as to liven up the fire when raising steam, or help out when atmospheric conditions are unfavorable.



HOWDEN'S FORCED DRAFT SYSTEM APPLIED TO A MARINE BOILER



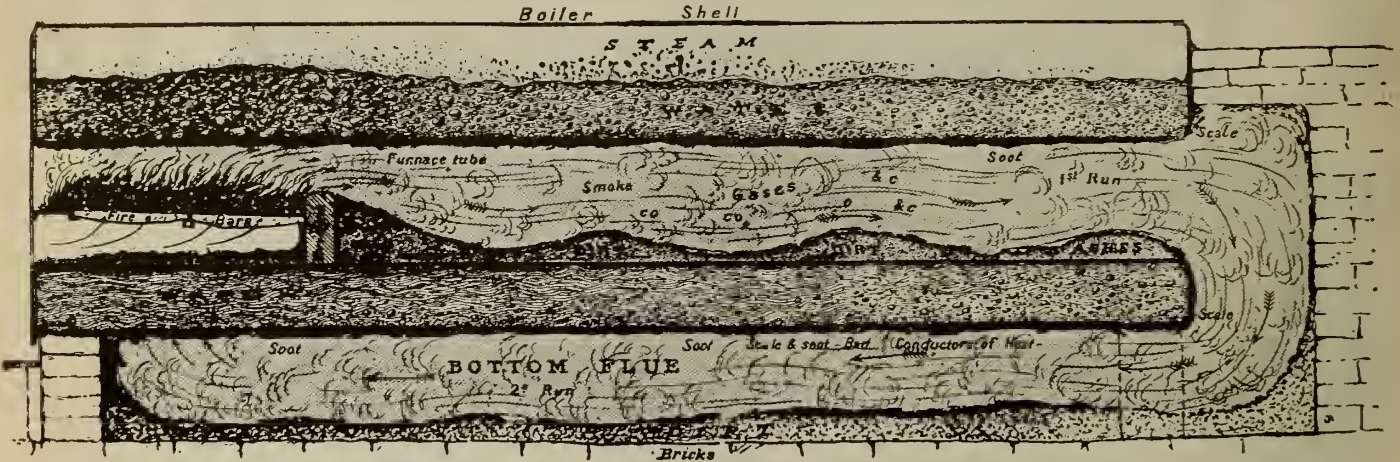
GREEN'S ECONOMIZER FOR HEATING FEED WATER BY HOT FLUE GASES.



SECTIONAL PLAN OF GREEN'S ECONOMIZER AND BOILERS, SHOWING PATH OF FLUE GASES TO CHIMNEY.

(2)—By an air blast delivered under the firegrate, through the medium of a closed ashpit, Howden's forced draft system being a typical example and of wide adoption both ashore and afloat. It has, in addition to effectiveness of purpose, the advantages of simplicity and lack of danger to the men on the firing floor. Air is supplied to the furnace by conduits at the sides of the smoke box containing a system of vertical tubes through which the hot air and gases from the smoke box flow to the stack. The waste heat in the stack is utilized to heat the incoming air to the furnace, and although the direct saving is not large, the indirect one is so from the fact that combustion of the fuel is much more complete and efficient, the nearer the air supply temperature approaches the temperature of combustion. The air supply is maintained and regulated by a fan, and is usually delivered at a pressure of from half an inch to one inch of water.

(3)—By making the boiler room airtight and forcing air into it by means of a fan until the pressure is above that of the atmosphere outside, the only outlet, as a result, being through the furnaces to the stack. Securing forced draft after this manner is known as the closed stokehold system, and its application and installation belong almost entirely to ships of war, and in some few instances to high power merchant vessels. The first cost is high and attendant risks are considerable.



SECTIONAL VIEW OF LANCASHIRE BOILER WITH TWO INTERNAL FURNACES, SHOWING MANNER IN WHICH SOOT, DIRT, ETC., COLLECT UNDER ACTUAL CONDITIONS.

(4)—Compared with Nos. 2 and 3, the latter at least, this, the induced system of artificial draft is simpler and less costly, the claim being made, in addition, that it is less trying to the tubes. As in the Howden system a fan is employed, its purpose being to draw the products of combustion from the stack base, and in one well known system, to deliver them to the stack again after passing through the tubes of a heating chamber. The inflow of air is through the heating chamber and downward to the furnace, being induced by the suction of the fan. The latter has to be carefully designed and constructed so as to successfully withstand the temperature of the stack gases with which it deals.

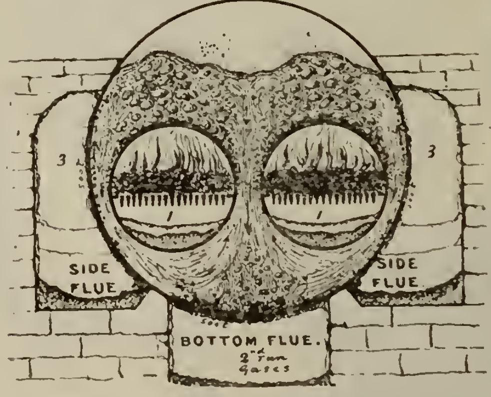
It may be noted here that with a powerful draft, however created, a smaller weight of air comparatively is sufficient to ensure complete combustion of the fuel.

Fuel Per Sq. Ft. of Grate

Twenty pounds of coal can be burned per sq. ft. of grate area per hour with good firing and ordinary stack draft, and up to possibly 25 pounds when conditions are exceptionally favorable. In the mercantile marine, 15 pounds per sq. ft. of grate area per hour is a good average under economical working conditions. With moderate forced draft 20 to 30 pounds per sq. ft. of grate area per hour can be burned, while with good air pressure—either forced or induced draft—30 to 50 pounds may be burned. With short grates and good firing, and forced or induced draft, 60 pounds of coal per sq. ft. of grate area per hour may be consumed. Locomotives, under exhaust blast only, burn from 65 to 80 pounds per sq. ft. of grate area per hour. With closed stokehold system of forced draft, and a pressure of 6 inches of water, practically 100 pounds of coal can be burned per sq. ft. of grate area per hour.

Stack Height and Area

Stack height and area are governed in practice more by circumstances than by scientific investigation, the diameter or area being fixed by arbitrary rules based on successful practice, and the height for appearance relative to the diameter or area, and to locational surroundings. With natural draft, however, the stack area and height from level of firebars are important factors. The draft in the stack, as we saw already, is due to the difference between the density of the column of gas inside same and that of the outside atmosphere, the stack contents rising on the same principle as does a bubble of air through water. The density of gases, of course, depends on their temperature at the stack base; it is, therefore, necessary in order to procure a satisfactory draft in the chimney that the gases temperature at its base be comparatively high. The good draft invariably noticed on a windy day is due to the tendency for a vacuum to form at the stack mouth because of the wind blowing across it.



APPROXIMATE REPRESENTATION OF VARYING RATES OF STEAM GENERATION IN DIFFERENT PARTS OF A LANCASHIRE BOILER.

PRESERVATION OF IRON PATTERNS

A METHOD of preserving iron patterns from rust and corrosion is first to subject them to an air blast to remove dirt and dust, and then to immerse them in a pickle composed of 5 gallons of water and 1 pint of sulphuric acid. This is used hot, and the patterns are allowed to remain in it for 5 min. The patterns are then rinsed in water and dipped into a hot potash solution made by dissolving 1 lb. of potash in 1 gallon of water, thus neutralizing the acid left in the pores of the iron. The patterns are allowed to remain in the solution for about 5 min., and are then scoured with a stiff brush to remove the rust and again dipped into the sulphuric acid for a minute or so. They are then rinsed in cold water and not allowed to dry, afterwards being immersed in a weak cyanide of potassium solution made by dissolving 2 oz. of the cyanide in 1 gallon of water. Copper plating takes place in the regular cyanide copper-plating solution used by all electroplaters. The solution is used hot, and the deposit need not be thick, the time necessary being usually from 5 to 10 mins.

The next step is to rinse and dry the patterns, after which they are warmed and paraffin wax rubbed over the surface as a thin coating. When cool, the surface is brushed with a bristle brush in order to smooth down and even up the paraffin coating. They are then ready for use. The paraffin protects the copper from corrosion and allows the pattern to leave the sand easily.

Question and Answer Series

Question.—What is understood by the term jet condenser as applied to a steam engine?

Answer.—By a jet condenser is meant the mechanical arrangement by which the exhaust steam from an engine cylinder is converted in water. It consists of a box or chamber into which the exhaust steam passes at its top end, and meets a jet or spray of water. The condensed steam is termed the water of condensation, the jet or spray the condensing water.

* * *

Question.—What is understood by the term surface condenser as applied to a steam engine?

Answer.—By a surface condenser is meant the mechanical arrangement by which the exhaust steam from an engine cylinder is converted into water by coming into surface contact with groups of small brass tubes (usually ½ in. to ¾ in. diameter), through which water is being circulated by a pump.

* * *

Question.—Under what particular service conditions are each to be found?

Answer.—The jet condenser is employed when a plentiful supply of fresh water is available, costing nothing, and the boilers are fed from the air pump hot well, the latter receiving both the water of condensation and the condensing water. The surface condenser, on the other hand, is used when fresh water is not available, the boilers being fed from the hot well, or otherwise. If fed from the hot well, only the water of condensation is available. A steamer plying on a fresh water lake and one plying on the ocean are excellent examples of the respective uses of each. Jet condensers are also largely used on stationary engines when fresh water is plentifully available.

* * *

Question.—Which is the more costly, a jet or surface condenser?

Answer.—The surface condenser costs considerably more, its detail construction and contributing mechanism being more elaborate.

* * *

Question.—What is understood by the term air pump as applied to a condenser?

Answer.—By the air pump is meant the apparatus by which the water of condensation and condensing water is withdrawn from the jet condenser, and by which the water of condensation only is withdrawn from the surface condenser.

* * *

Question.—Would the air pump be of the same size for both a jet and surface condenser in the same size or horsepower engine?

Answer.—No, the air pump would be considerably larger with a jet condenser, because it has much more work to do, the latter involving as in the answer to the previous question the handling of both the water of condensation and the condensing water.

* * *

Question.—Is there any difference in the speed with which water and steam will escape from the same boiler?

Answer.—Yes. Volume for volume. the steam will escape about twenty times as fast as the water.

* * *

Question.—What is the effect of accumulation of scale and soot on the heating surfaces of a boiler?

Answer.—A coating of soot or scale, however thick or thin, is a bad conductor of heat, hence heat is prevented from getting as rapidly and as effectively to the water as it otherwise would were the plate surfaces clean, and to get the same amount of steam from the boiler in the former case, extra coal is needed to the following degree:—1-16 inch of scale necessitates 15 per cent. extra fuel; ⅛ inch of scale necessitates 32 per cent. extra fuel; ¼ inch of scale necessitates 66 per cent. extra fuel; ½ inch of scale necessitates 150 per cent. extra fuel.

* * *

Question.—What are some of the causes that may prevent an injector from working satisfactorily?

Answer.—Leak in suction pipe, too low steam pressure, foaming boiler, dirt, such as iron scale, red lead, etc., in tubes, strainer getting clogged up, loose lining in suction hose, bad check valve, etc.

* * *

Question.—What is understood by the expression "water circulation" as applied to a steam boiler?

Answer.—Water is a poor conductor of heat, and must, therefore, be heated by its passing rapidly over heating surfaces so as to expose all its particles to the heat. When water is heated, it expands, becomes lighter and rises; at the same time, cold water rushes in to take its place. The current thus set up is termed "circulation," and the stronger the current the better for many reasons.

* * *

Question.—A steam boiler 16 feet long and 72 inches in diameter, is made of material ½ inch thick, and carries a pressure of 80 pounds per square inch gauge. What is the stress in the shell-plate?

Answer.—The total pressure tending to disrupt the shell would be the total pressure on the longitudinal cross section, which is $16 \times 12 \times 72 \times 80 = 1{,}105{,}920$ pounds. This pressure is distributed over twice the cross sectional area of the plate, or a surface equal to $16 \times 12 \times 2 \times \frac{1}{2} = 192$ square inches. Stress in shell plate is, therefore,

$$\frac{1{,}105{,}920}{192} = 5{,}760 \text{ lbs. per sq. in.}$$

The figure 12 in the formula is employed to bring the boiler length in feet to inches. Further as the tensile strength of boiler shell plates is usually about 60,000 lbs. per sq. inch, it will be noted that the margin of safety is about 10 times that of the working tensile stress.

* * *

Question.—Why is it wrong to feed much cold water to a boiler or let much cold air into the furnace and over the fire?

Answer.—Those parts of the boiler to which the cold feed water or cold air has more or less direct access are cooled unnecessarily, thus setting up hurtful strains as between the hotter and unaffected parts. Comparatively small changes of temperature so produced, will if often repeated, start leaky joints, rivets, etc., as well as contribute to breakage of stays, etc.

* * *

Question.—When examining the interior of a steam boiler what are some of the defects to be looked for and expected?

Answer.—Loose and broken stays and loose rivets; effects of corrosion, such as pitting, grooving, etc.; fractured, burned and laminated plates; defective blow-off connections; thin and defective tubes, etc.

Question.—What should be the chief aim in firing a steam boiler?

Answer.—To secure a complete combustion of the fuel and its gases, so as to prevent the formation of smoke and soot, and at the same time to permit as little excess of air in the furnace as possible, this simply carrying heat up the stack as waste.

* * *

Question.—What would you suggest as a satisfactory method of banking a fire?

Answer.—Push the live coals back against the bridge wall so as to leave the forward part of the grate covered with ashes. Cover the fire with a fairly thick layer of fine coal and some ashes. Leave the damper open a very little to prevent the collection of gas and possible explosion. When starting up, it is simply necessary to pull the fire evenly forward and shovel on fresh coal.

* * *

Question.—What points should be observed in connecting up the water column of a steam boiler?

Answer.—Connecting pipes should not be smaller than one inch in diameter and preferably of extra heavy pipe or drawn brass tubing. Bottom pipe should be connected with a ground joint brass union so that the bottom of the water glass or the bottom gauge cock will be at least $1\frac{1}{2}$ inches above the top row of tubes. Plugged tees should be used instead of elbows to allow cleaning. The bottom pipe should be level and fitted with a gate valve blow-off.

* * *

Question.—A motor running at a speed of 1,000 r.p.m. drives a fan through a countershaft. A 10 in. pulley on the motor drives to a 30 in. pulley on the countershaft, which in turn drives a 20 in. pulley on the fan from a 50 in. pulley. Find the speed of the fan.

Answer.—Drivers are 10 in. and 50 in. Driven are 30 in. and 20 in. Speed of fan, therefore, is

$$\frac{10}{30} \times \frac{50}{20} \times 1{,}000 = 833.33 \text{ r.p.m.}$$

* * *

Question.—What should be the thickness of a 10 in. cast iron water pipe to carry a steady pressure of 200 pounds per sq. in. Ultimate tensile strength of cast iron 20,000 lbs. per sq. in.?

Answer.—Using a factor of safety of 10, the working stress would be $\frac{20{,}000}{10} = 2{,}000$ lbs. per sq. inch.

Pressure tending to disrupt pipe is

$$\frac{10 \times 200}{2} = 1{,}000 \text{ pounds.}$$

Area of metal necessary to resist this

$$= \frac{1{,}000}{2{,}000} = .5 \text{ sq. inches.}$$

As we are considering a section 1 in. long, the required thickness would, therefore, be .5 in. or $\frac{1}{2}$ in.

* * *

Question.—What points should be observed in shutting a plant down indefinitely?

Answer.—Before blowing off, fill the boiler fairly full and put about a gallon of crude oil into the steam space so that, as the water goes down, a coat of oil will be left on the inside of the boiler to prevent rust. When starting up again, clean boiler thoroughly. Clean oil out with soda. Clean soot from flues and furnace parts and cover with a coat of boiled linseed oil. If boiler cannot be emptied when shutting down, fill up completely with water, to which is added some soda ash. Boil off air and close up tight. Cover stack top with water-tight hood if possible and arrange to prevent dampness from entering through breechings, holes in the roof or elsewhere.

* * *

Question.—Why is it that a pump will force water into a boiler against a pressure equal to or greater than the steam that operates it?

Answer.—The area of the steam piston is always greater than the area of the pump plunger, so that if the pressure per sq. inch on steam piston and against pump plunger be the same, the total force or load on the steam piston will be greater than that against which the pump plunger is directed.

* * *

Question.—What procedure is adopted in setting the valves of a duplex pump?

Answer.—First take off the steam chest covers and set both rocker arms exactly plumb. Measure carefully the width of steam ports and place both valves centrally over ports. Set up jam nuts to within half the width of the ports from the valves and lock them in this position. Valves should move in opposite directions to open ports. Replace covers and pump is ready to start.

* * *

Question.—What width of double-ply leather belt would be required to transmit 200 horse-power from a 10-foot pulley at 100 r.p.m.?

Answer.—Using formula

$$w = \frac{\text{H.P.} \times 300}{V}, \text{ in which}$$

w = width of belt in inches.
H.P. = horse-power transmitted.
V = velocity of belt in feet per min.
300 = a constant for double belts.
V = circumference of pulley × r.p.m.

or

$V = 3.1416 \times 10 \times 100 = 3141.6$ ft. per minute.

Then

$$w = \frac{200 \times 300}{3141.6} = 19.098 \text{ inches,}$$

or, say, a 20-inch belt.

Question.—Will a boiler shell burst by ripping lengthwise or in a circular direction?

Answer.—Let the diameter be represented by D and the internal pressure by P. The force tending to split the shell lengthwise is $\frac{D \times P}{2}$. The force tending to rupture it in a circular direction is

$$\frac{D^2 \times .7854 \times P}{D \times 3.1416} = \frac{D \times P}{4}$$

The longitudinal strength is, therefore, only half of the transverse strength.

* * *

Question.—What is the approximate water capacity in gallons of a return tubular boiler, 18 ft. x 72 in. with 72 3-inch tubes?

Answer.—Rule, from 2-3 the volume of the shell subtract the volume of all the tubes.

Volume of 2-3 of shell $= 72 \times 72 \times .7854 \times 18 \times 12 \times 2\text{-}3 = 586{,}297.9584$ cu. in.

Volume of one tube is approximately $3 \times 3 \times .7854 \times 18 \times 12 = 1526.8$ cubic inches.

Volume of 72 tubes $= 109{,}929.6$ cubic inches.

Volume of water contained $= 586{,}297.9 - 109{,}929.6 = 476{,}368.3$ cubic inches.

$$\text{Number of gallons} = \frac{476{,}368.3}{277.274} = 1718.04$$

* * *

Question.—An engine piston rod is $3\frac{1}{4}$ inches in diameter, and the stuffing box is bored to $4\frac{3}{4}$ inches. How much square flax packing will be required if the box is filled by 5 rings?

Answer.—The mean diameter of the ring is $3\frac{1}{4} + \frac{3}{4} = 4$ inches.

Length of each ring is $4 \times 3.1416 = 12.5664$ inches.

Taking off about 0.1 inch for closing up, this becomes 12.46 inches, or for 5 rings $12.46 \times 5 = 62.3$ inches, or a little over 5 feet.

* * *

Question.—A common squirt oil can has a body shaped like a segment of a sphere. Its base diameter is 4.5 inches and its height is 2.1 inches. How many times could it be filled from a can containing a gallon

Answer.—The volume of a spherical segment is three times the square of the radius of the base plus the square of the height multiplied by the height and by .5236.

Radius of base = 2.25; $2.25^2 \times 3 = 15.187$.

Height squared $= 2.1^2 = 4.41$.

$4.41 + 15.187 = 19.597$; volume $= 19.597 \times 2.1 \times .5236 = 21.5477$ cub. ins.

$$\text{Number of fillings} = \frac{277.274}{21.5477} = 13.2$$

Steam Power Plant Auxiliaries

BOILER FEED PUMPS—III

A VERY complete line of boiler feed pumps is built by the American Steam Pump Company, Battle Creek, Mich. These are known as the Marsh pump and are designed for a maximum working pressure of 150 lbs. per square inch. They are built in twenty-three sizes, ranging in capacity from 20 boiler horse-power to 3,500 horse-power on a basis of four gallons per horse-power per hour at moderate speed.

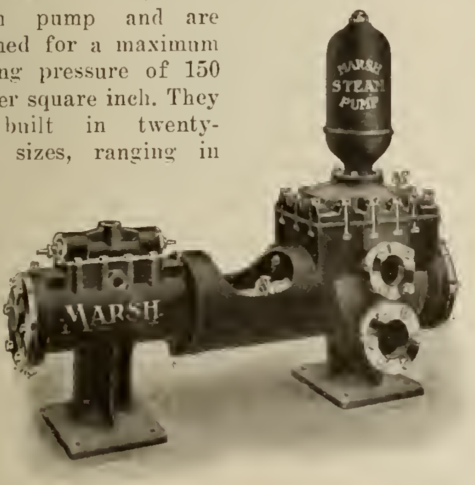


FIG. 12—EXTERIOR VIEW OF "MARSH" SIMPLEX PUMP

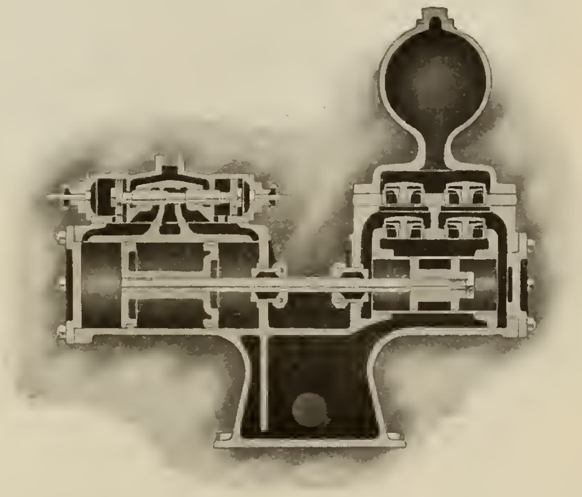


FIG. 13—TYPE B TO D "MARSH" PUMP IN SIZES 2½ X 1⅝ X 2 IN. TO 5 X 3 X 3½ IN.

"Marsh" Simplex Pumps

All of these pumps are of the simplex piston type and are illustrated in Figs. 12 to 16. The pump shown in Fig. 12 is typical of the larger sizes, sectional views of which are shown in Figs. 15 and 16, while Figs 13 and 14 are sectional views of the smaller sizes.

All Marsh boiler feed pumps are fully bronze-fitted, including solid bronze piston rods, and excepting in the four smaller sizes, cast bronze removable water cylinder bushings; pressed-in bronze bushings are fitted in the smaller sizes. The design adopted for sizes B to D, Fig. 13, is simple and compact, the two cylinders and base forming a single casting. In sizes C-2 to H, the steam and water cylinders are attached to the base, which in both of these designs forms a suction chamber, to which the suction pipe may be attached on either side. Being self-contained, these do not require large and expensive foundations.

To the left of the suction chamber will be noticed a baffle plate which is used in conjunction with an exhaust deflecting valve, by means of which the exhaust steam may be directed into the suction chamber of the pump, where it is condensed and combined with the water being pumped, thereby warming the water by adding the heat in the steam used to operate the pump.

In the pumps shown in Figs. 15 and 16, the cylinders are cast with separate bases. The steam and water cylinders are joined by heavy cast iron yokes with ring and plug fit to insure perfect alignment of wearing parts. In the largest sizes hand hole plates are fitted giving immediate access to all water valves, and the water end is built in three parts, thus obviating the necessity of purchasing an entire water end in the event of breakage. Rubber disc valves are fitted to all sizes, except the four smallest.

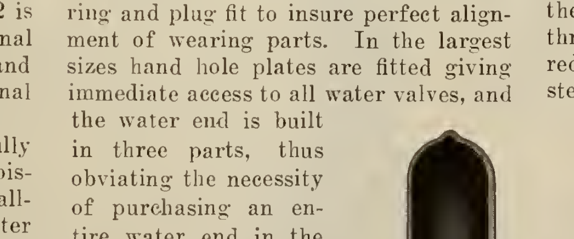


FIG. 14—TYPE C2 TO H "MARSH" PUMP IN SIZES 4 X 2½ X 6 IN. TO 7 X 4 X 8 IN

The steam end of the Marsh pump, which is of considerable interest, contains only two moving parts—the steam valve which moves backward and forward in the steam chest on top of the steam cylinder, and the steam piston itself. There are no moving parts on the outside and no tappets on the inside. Reference to any of the illustrations will show that steam which enters through the inlet on the top, passes to the left through the opening formed between the reduced neck of the steam valve and the steam chest, thence passing down through the port at the bottom of the steam chest and into the end of the steam cylinder. The steam piston is of a spool form, each head of which is provided with metal packing rings, the space between the heads forming a reservoir for live steam. This steam is supplied by a port in the steam chest above the valve, and passes, as shown by the white lines on the cuts to a point in the cylinder head or cover, from whence it passes through the central tube into the hollow piston rod and thence into the interior of the piston. As the piston moves to the right, the live steam which it contains passes through the port indicated by an arrow, and by pressing on the right hand end of steam valve forces it over to the left, closing the admission port at that end and admitting steam to the right of the piston, thus reversing the travel. In Fig. 13, the steam piston is made extra long and by means of suitable ports dispenses with the use of a hollow piston rod in the smallest sizes.

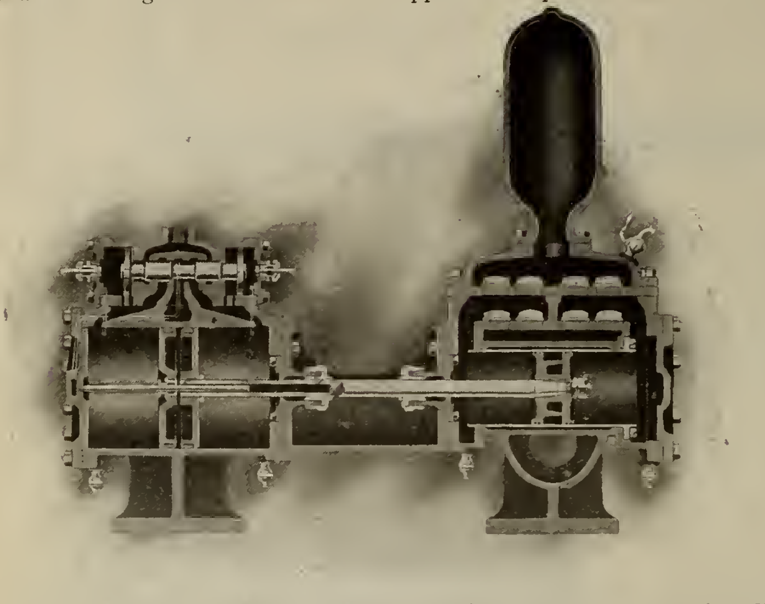


FIG. 15—TYPE HB TO N "MARSH" PUMP IN SIZES 7 X 4½ X 10 IN. TO 14 X 8½ X 12 IN.

''Deane'' Single and Duplex Pumps

Boiler feed pumps of both the single and duplex types are built by the Deane Steam Pump Co., Holyoke, Mass., the principle constructional features being illustrated in Figs. 17 and 18. The first of these shows the single pump which is made in eleven sizes of this type, from 50 to 500 boiler horse-power. Larger sizes, having capacity up to 8,000 boiler horse-power have a somewhat different style of water end with hand hole plates for access to the valves, which arranged in such a manner that the pump is always primed and ready to start.

The valve gear of the Deane single pump consists of few parts which are arranged to work in the same vertical plane thus avoiding various mechanical complications. The valve parts comprise a main valve and supplemental valve which are both flat slide valves, also a supplemental piston which is driven by the direct pressure of steam on alternate ends. The mechanical operation is as follows; the piston rod arm is securely fastened to the piston rod, and through the connection of lever and links, its motion causes the tappet block to slide back and forth on the valve rod between the two tappets. These tappets are keyed to the valve rod so that when the tappet block strikes either tappet it carries with it the valve rod and secondary valve, which uncovers a small port allowing steam access to one end of the valve piston, throwing it over and operating the main valve so as to admit steam to the pressure side of the main piston. The correct timing of the valve movements is dependent on the position of the tappets. If they are too near together, the valve will be thrown too soon and the pump short-stroked, and if too far apart, the pump will complete its stroke without moving the valves.

The Dean duplex pump is shown in Fig. 18, which a section of the whole pump with a plan view of the steam end and valve motion above, the steam chest cover being removed to show the valves. The duplex pump being practically two pumps side by side, enables the auxiliary valve and piston to be dispensed with; the slide valve which controls the admission and exhaust of steam for one piston receives its motion from the other piston. As explained before, it is desirable that the steam pressure should be maintained clear to the end of the stroke, and to accomplish this the steam port must remain open, or partially so, until the piston has reached the end of its travel. The difference between the thickness of the valve rod collars and the space between the lugs on the valves accomplishes the result by allowing the piston to travel a certain distance before starting to move the valve. The amount of this lost motion is carefully determined and accurately fixed by the makers, thus avoiding any subsequent adjustment.

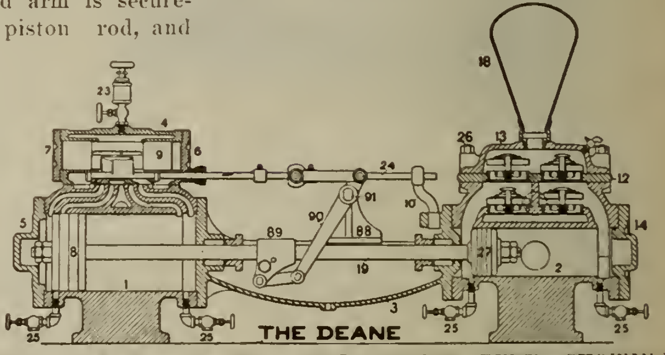


FIG. 17—THE "DEANE" SINGLE STEAM PUMP, SHOWING DETAILS OF CONSTRUCTION

''Cameron'' Boiler Feed Pumps

Boiler feed pumps built by the A. S. Cameron Steam Pump Works, New York, are of both simplex and duplex types. The simplex pump is illustrated in Fig. 19, which shows the interior of the steam valve arrangement. The entire mechanism consists of four pieces only, all of them working in direct line with the piston.

The main slide valve G, controls the distribution of steam to the cylinder A, and is operated by the chest plunger F, the right hand end of which is shown in section; C is the piston; L, the steam

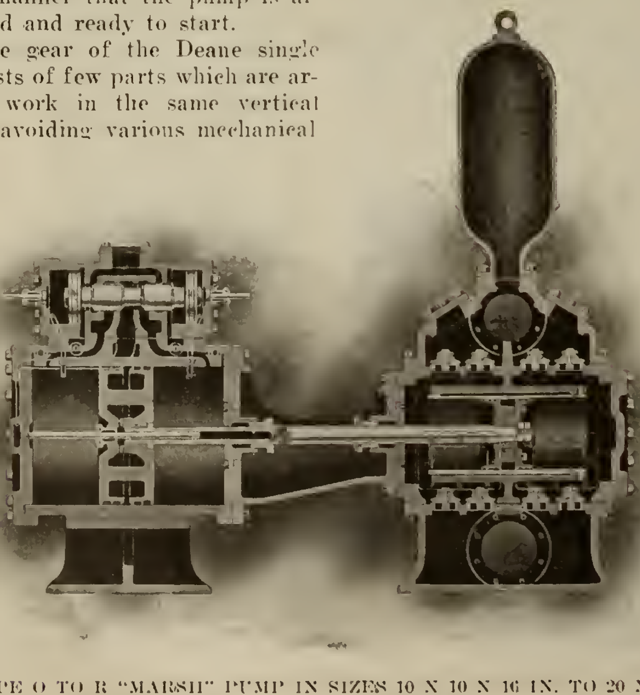
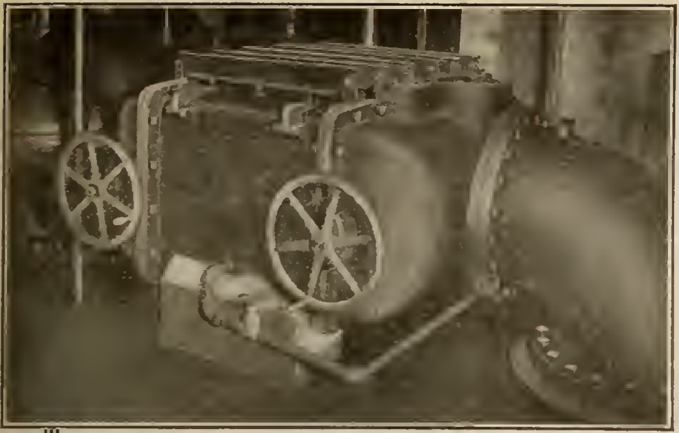


FIG. 16—TYPE O TO R "MARSH" PUMP IN SIZES 10 X 10 X 16 IN. TO 20 X 12 X 20 IN.



24" Twin Strainer in condenser circulating water line.

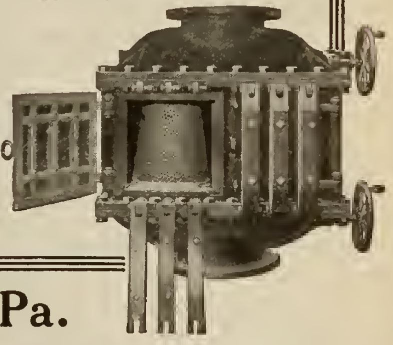
Twin Strainers

Insure Continuous Service

The Twin Strainer stands on guard twenty-four hours a day, and removes from the water all such foreign matter as dead leaves and grass, sticks, fish, etc., that would clog up and injure the pump and condenser.

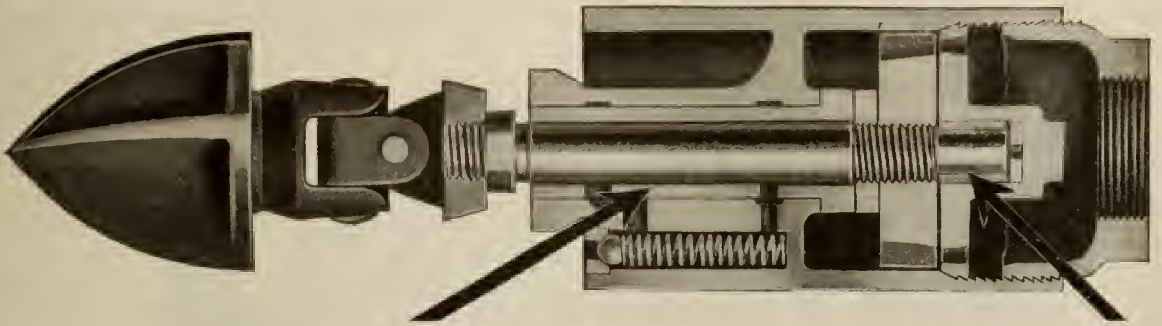
The Twin Strainer is the only direct-flow strainer that can't be clogged. When the solids accumulate in one of the two straining baskets, a clean one is put in service by simply operating two valves. The dirty basket can then be lifted out, carried to a convenient place, cleaned, and replaced in the Strainer—all this without interrupting the supply of water for an instant.

Twin Strainers are made in sizes ranging from 1 to 48 ins. with perforations in the straining baskets to suit your service.



Twin users are the best boosters we have. Send for a copy of Bulletin "A" and join the army.

Elliott Company, 6902 Susquehanna St., **Pittsburgh, Pa.**



BUSHED BEARINGS ARE BEST

IN A TUBE CLEANER

Because the weight of the rotating parts is so small that the friction load on any type of bearing in good condition is negligible compared with the load of removing scale.

BUT—there is a shock load due to vibration. And you know that ball and roller bearings will not stand up under shock. And it is impossible to keep the grit and dust from the scale out of ball or roller bearings.

The LIBERTY CLEANER uses bushed bearings which do stand up under shock and which are practically impervious to grit. On account of wear, the friction load on ball or roller bearing Tube Cleaners increases rapidly with use. Friction load on LIBERTY bearings does not increase.

GET THE BEST—GET THE LIBERTY.

LIBERTY MANUFACTURING COMPANY 6904 Susquehanna Street
Pittsburgh, Pa.

Canadian Representatives: Williams & Wilson, Ltd., Montreal; A. R. Williams Machinery Co., Toronto and Winnipeg

chest; H, a lever by means of which the chest plunger F may be reversed by hand; I, I, are reversing valves which are alternately operated by the steam piston at either end of its stroke. When not opened by the piston these reversing valves are kept in the position shown by live steam pressure from the steam chest. Both ends of chest plunger F, are hollow, and have holes allowing the steam pressure to balance all over, so that the passage leading to the left hand reversing valve is now filled with live steam. When the piston opens the reversing valve at the end of its stroke, this steam is allowed to escape so that the chest plunger F is relieved of pressure on this end and is instantly thrown over, carrying slide valve G and reversing the motion of the piston.

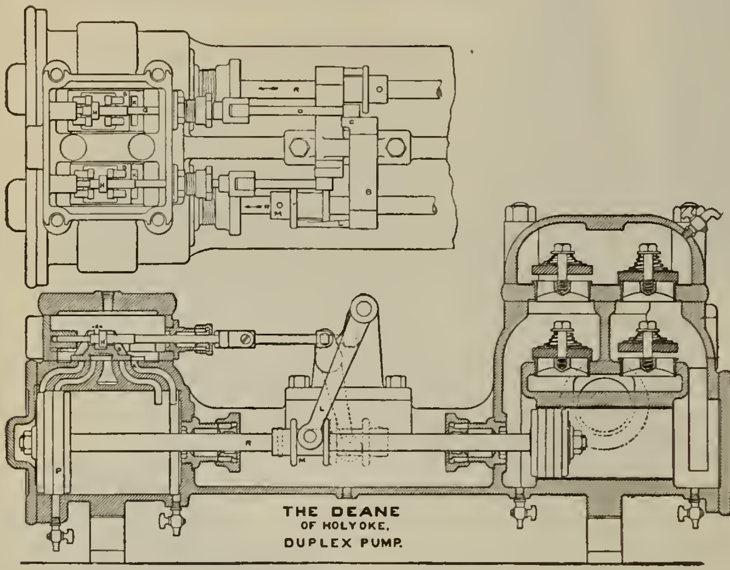


FIG. 18—THE "DEANE" DUPLEX PUMP WITH PLAN OF VALVE GEAR

Fig. 19 also illustrates the Cameron valve chest and arrangement of water valves. By removing one bonnet or cover, the whole interior, with every valve, is plainly visible. The shelves or decks are bored out tapering, and the brass seats forced in, being thus readily renewable. Each stem holds two valves with their springs one above the other so that by unscrewing one plug, and pulling up the stem, both are released.

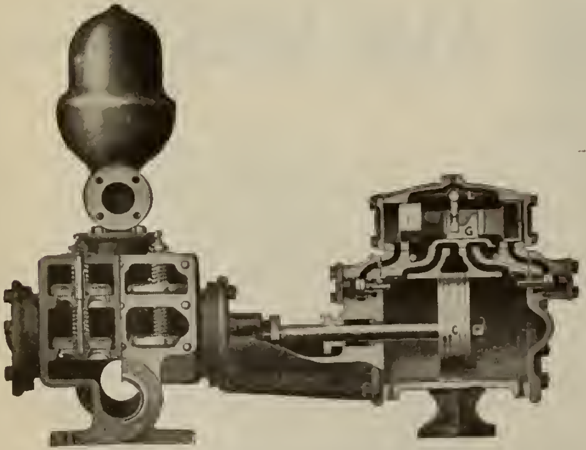


FIG. 19—SECTIONAL VIEW THROUGH "CAMERON" SIMPLEX BOILER FEED PUMP

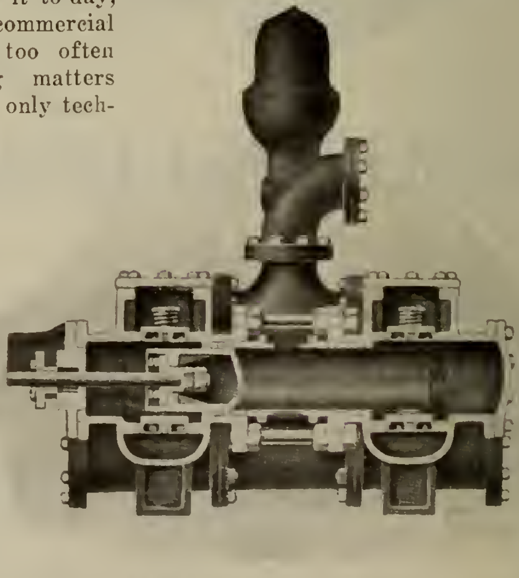


FIG. 20 — WATER END OF "CAMERON" OUTSIDE CENTER PACKED PLUNGER PUMP

Cameron duplex pumps are made in a large range of sizes for working pressures of 150 lbs. per sq. in., and in numerous types. Fig. 20, shows the water end of the outside centre packed plunger pattern, so arranged that the plunger may be packed from the outside without requiring the removal of the cylinder head, and also permitting the packing to be tightened while the pump is in operation.

* * *

COMMERCIAL SIDE OF ENGINEERING

by F. G. Hatch

ENGINEERING, as we know it to-day, could not exist without its commercial side. The young engineer too often thinks that all engineering matters should be regarded as having only technical interest, and that commercial considerations are beneath the notice of the engineer. Well, abstract science is of very little value to the everyday world until it has been commercialised in some form or another.

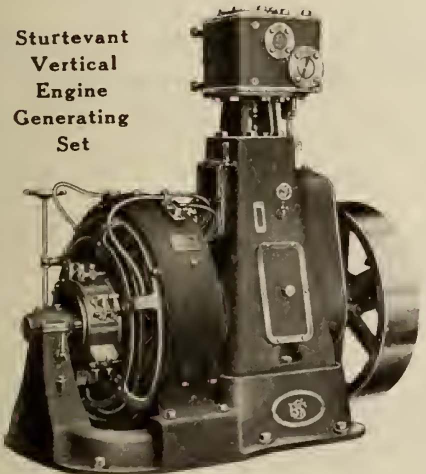
Of what value to the world at large would Stephenson's invention of the locomotive have been if, after he had made his first engine, it had been described in papers, examined by learned professors, looked upon as an interesting novelty, and—allowed to rust? Its value to mankind became apparent and real when it was seen to open up a new era in transportation, then commercial men advanced the money to build a railway, by means of which it was demonstrated that goods were hauled cheaper and quicker than had previously been possible.

Is this aspect of their work sufficiently borne in mind by engineers? The writer ventures to think that it is not, especially by younger members of the profession or business, whichever you like to name it. It is an aspect of his future work which is rarely mentioned by his early teachers and masters, and it is seldom mentioned in the classes of college or technical school.

When the young engineer enters a works for his practical training, the one part that he never spends any time in is the commercial offices. His training is supposed to be completed when he has been through the shops and drawing-office, although he may have only the vaguest notions as to how material is bought and the products of the works are marketed and sold. He knows practically nothing of such things as costs, capital charges, profits and loss accounts, and balance sheets.

Is it any wonder, and can it be otherwise, in view of the fact that engineering students receive no regular business training, that engineers, as a whole, are poor business men

Why Run the Big Engine When Only Part of the Force Is Working?



Sturtevant
Vertical
Engine
Generating
Set

When only part of the force is working at night it wastes money to run the large engine. This is a useless expense which can be done away with by installing a

Sturtevant Engine Generating Set

They are small units made in sizes up to 100 kilowatts with vertical engines and up to 150 kilowatts with horizontal engines. In some plants they will carry the whole load. A decided saving can be made with one suited to your needs. Sets with turbine drive are also furnished.

WRITE FOR CATALOGS

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B. F. Sturtevant Company of Canada, Limited
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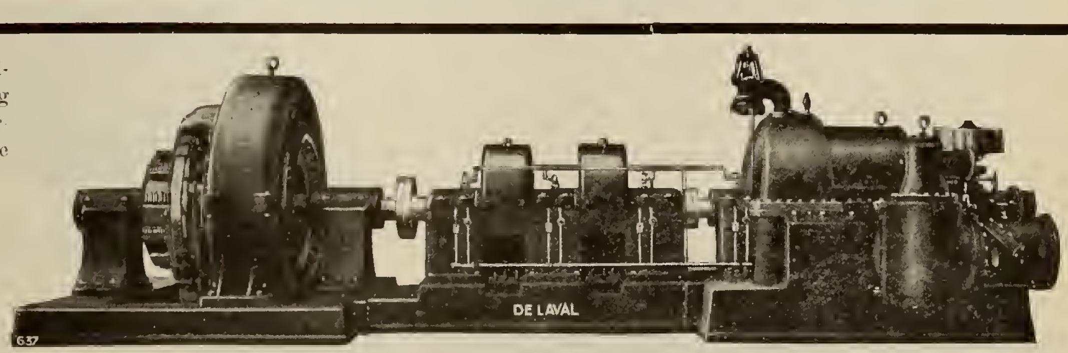
De Laval 1,200 kw. Multi-stage Turbine Driving Standard-speed Direct-current Generator through De Laval Speed-reducing Gear; utilizing low-pressure steam and supplementing with high-pressure steam as required to carry the load.



The DeLaval Double Helical Gear is the Pioneer Gear of this Type by Over Twenty-Five Years

Since the first De Laval gear reduction was built, the De Laval Steam Turbine Company has produced some 6,500 gear reductions and has introduced numerous improvements in design, materials and methods of manufacture. The building of high-speed turbine gears requires an expensive equipment of special machinery and must be performed carefully and accurately by highly trained men. Only in this way can absolutely correct tooth contours, spacing, angles and alignment—which are essential to smooth and noiseless running—be obtained. Gears which are correctly cut in the first place, rigidly supported in the correct position, and properly lubricated, will run indefinitely without trouble or wear, while gears that are not correctly cut will not run satisfactorily, no matter how supported.

The De Laval gear has made the steam turbine universal. If you need more power for any purpose, as for generating current, driving pumps and blowers, or for rope or belt drive, a De Laval turbine can produce it for you, using live steam or exhaust steam, or both together. You may be able to double your power production without putting in more boilers or burning more fuel.

Write for book—D-61—"Use of Steam Turbine to Increase Plant Economy."

DE LAVAL
STEAM TURBINE CO., TRENTON, N. J.
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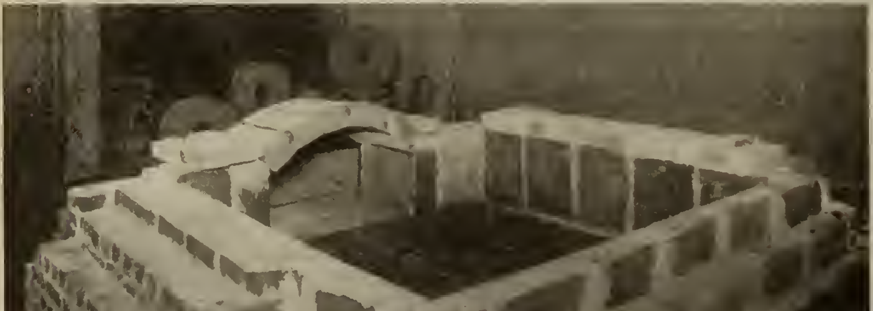
Progress in New Equipment

NEW FURNACE LINING

IN a large number of instances the ordinary fire-brick lining in boiler furnaces requires to be renewed at least once, and often as many as three times annually. This trouble is due to the fact that the first two or three courses of fire-brick are fused by the high temperature of the furnace, and consequently these bricks fall to pieces and loosen up the other courses. This causes short-circuiting of the gases and the resultant loss of a considerable percentage of the furnace heat which passes out through these crevices, materially reducing the boiler efficiency.

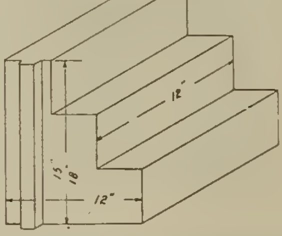
To overcome this objection and eliminate the necessity of frequent re-lining, J. W. Gates, of Montreal, has designed and constructed a new type of furnace, to remove these disadvantages and effect an appreciable saving in the operating expenses of heating or power plants. As shown in the cut, the lower courses of brick which come in direct contact with the extreme heat of the fire are replaced by specially shaped blocks, which give an exposed area of from six to eight times that of the ordinary fire-bricks. These brick are of special design, each being equal to three ordinary courses in thickness, two in length, and from four to six in height. In addition to the large fire area, each brick or block is interlocked on the ends with tongue and groove. The general construction of one of these blocks is shown in the line cut.



FURNACE SETTING BUILT WITH SPECIAL BRICK.

Ordinarily these blocks are 12 inches in width, 12 inches thick at the base, with a height of 15 to 18 inches; but in special cases the design can be changed to conform with local conditions. These fire-brick are constructed to withstand a test of 1,700 degrees Centigrade.

As the joints between the courses are the chief factor in preventing the escape or loss of useful gases, it is readily seen that the increased area of smooth surface, and the reduction in possible heat leakage, will reduce to a minimum the formation of clinker on the walls of the furnace. The interlocking principle also applies to the furnace door arch; these blocks being so ranged that it is practically impossible for the arch to fall away.



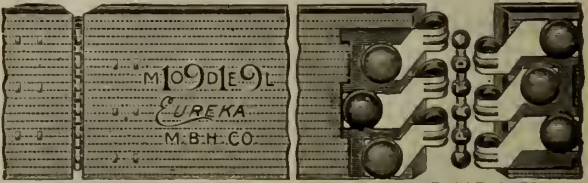
TYPE OF BRICK USED IN FURNACE SETTING

Another important feature in connection with this installation is the ease with which the lining can be renewed. The key course is first removed and the large blocks can then be taken out without disturbing any of the other boiler brick work.

A BALL BEARING BELT COUPLER

A BELT coupler possessing interesting features of construction is offered to belt users by the Manufacturers Belt Hook Co., Chicago. The device is adaptable to all kinds of belting, and consists of steel clasps for the belt ends, and a steel spindle with ball-shaped swellings, each of which is enclosed by a section of the clasp. The clasp sections are steel stampings, one end being formed with hooks, which are driven into the belt when the other end is riveted on top with a bifurcated rivet which clinches on the lower surface of the belt.

The result of this construction is to give a ball bearing, noiseless, detachable, flexible steel belt lacing which can be attached with a hammer and used over again when required.



PULLEY SIDE, ATTACHED

TOP SIDE, DETACHED

AUTOMATIC ROLLER BEARING

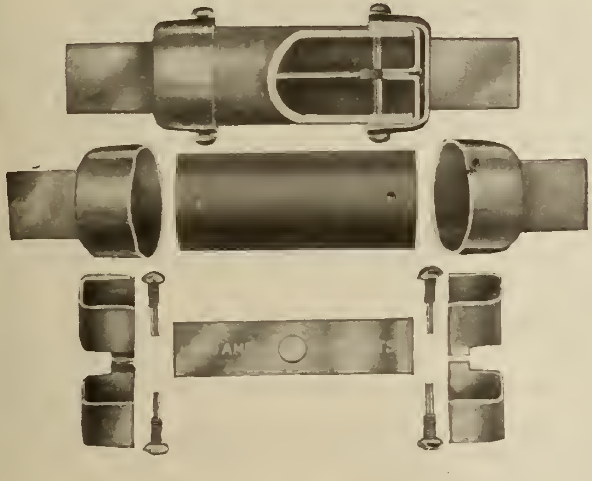
A COMBINED roller and ball bearing, in which the radial load is taken by tapered rollers, and the end thrust by balls, is now being produced by the George Automatic Roller Bearing Co., Cincinati, O. The idea of tapered rollers is not new, but the manner of combining the rollers and balls is new, the result of the construction being that rollers with an appreciable variation in size may be used, and they will adjust themselves so as to distribute the load equally on large and small rollers, the adjustment being automatically brought about by means of balls located between the ends of the rollers.

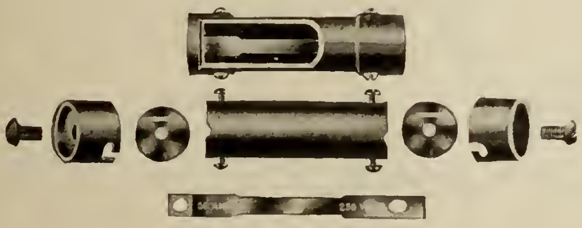
It is claimed for this bearing that in mounting great accuracy in machining is unnecessary. As will be noticed in the sectional drawing, the inner and outer surfaces of the bearing are tapered, hence concentricity is obtained by moving the bearing laterally in the housing. Both ends of the rollers are ground to a concave form, of slightly larger radius than the corresponding ball. When the

It is much cheaper to buy "fills" than Fuses

For what you are now paying for 25 non-refillable fuses you could buy many times that number of refillables.

The renewing of **Monarch Refillables** is a simple and easy matter. Takes only two minutes of your time.





The "Monarch" Refillable Fuse

is constructed with all parts Die Stamped, making the parts accurate and interchangeable, thereby making the **refilling very simple,** as the different parts will fit either cap. Our SPRING GRIPPING contacts are made of copper, assuring proper carrying capacity and cooling surface.

The "Monarch" Refillable Fuse Plug—

Edison Base

No screws or tools needed to refill the Monarch Refillable Plug.

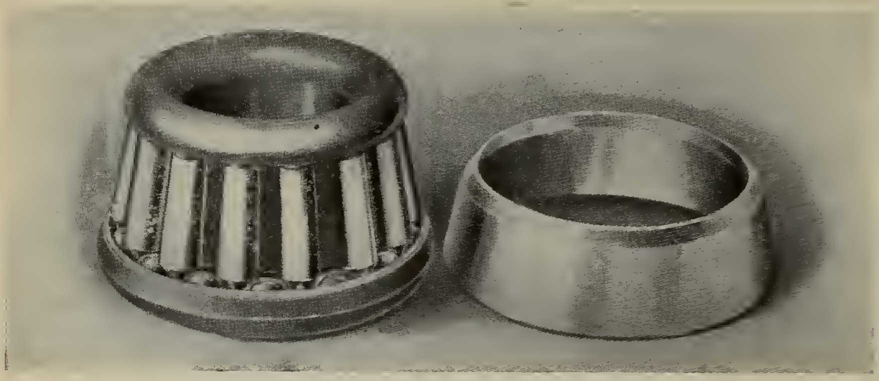
It is simple in construction, serviceable and a money saver.

Dealers and agents in open territory will find it worth their while to investigate our proposition.

The Monarch Refillable Fuse Co.

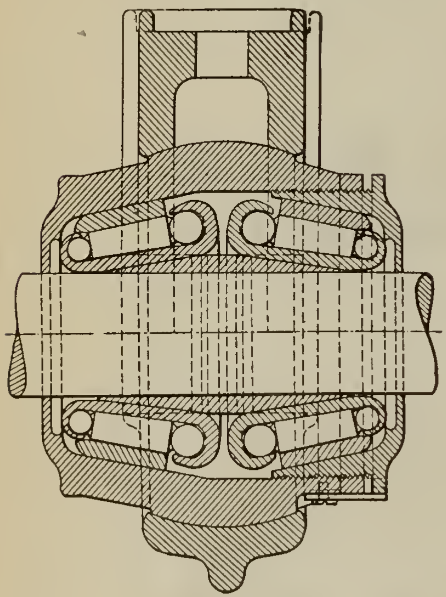
HAMILTON, CANADA

MONARCH REFILLABLE FUSE
A Sure Contact



THE "GEORGE" AUTOMATIC ROLLER BEARING.

bearings are tightened in place a wedging action occurs on the rollers, so that by the time the bearing has made a half turn, any rollers which may happen to be a trifle large are forced endways, causing the balls at that end to spread and act upon the ends of such rollers as may be slightly under size. These smaller rollers are thus forced back toward the smaller end of the bearing until they make proper contact with the working surfaces. Both rows of balls act as spacers, while the row of larger balls also acts as a thrust bearing to counteract the tendency of the rolls to creep laterally.



SECTION OF LINE SHAFT BEARING.

The bearing is easily assembled and disassembled by means of a small slot in the periphery of the large race which allow the last ball to be put in place when assembling, or taken out when disassembling. When in normal working position the slot does not interfere with the action of the balls.

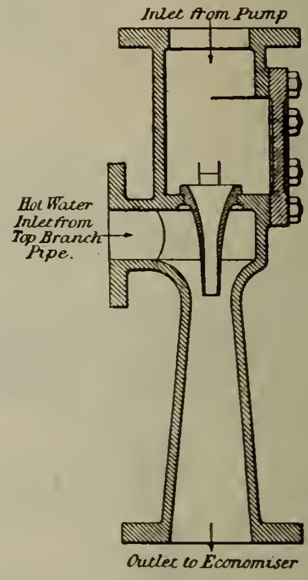
The makers state that they are prepared to furnish bearings to fit parallel holes, interchangeable with the long series type of other roller bearings.

SEPARATING THE ROLLERS SO THAT THE FIRST BALL DROPS OUT, AND SHOWING BEARINGS DISASSEMBLED.

FEED-WATER CIRCULATOR

THE illustration and description refer to what is known as the National circulator, the object of which is to raise the inlet temperature of the water which enters economisers, and thus to prevent the external wasting of the economiser-pipes. The water, on entering the economiser, should be at a temperature of above 100 deg. Fahr., otherwise a portion of the flue-gases in contact with the economiser-pipes condenses on the external surfaces of the pipes and sets up a wasting action, which leads to costly pipe renewals. Corrosion due to damp brickwork also progresses more rapidly when the temperature of the feed-water at the inlet end of the economiser is low.

The circulator is manufactured by the National Boiler & General Insurance Co., Manchester, England. It is mounted in the feed-pipe, between the feed-pump and the bottom branch-pipe of the economiser. As will be seen, the inlet from the pump is at the top, and the outlet to the economiser at the bottom of he circulator. A pipe connects the circulator to the top branch-pipe of the economiser, and by this means the circulator automatically draws hot water from the top branch-pipe into the cold feed supply, thus raising its temperature and preventing a chilling effect on the economiser-pipes. Access to the nozzle is obtained by removing the bolted cover shown in the illustration.

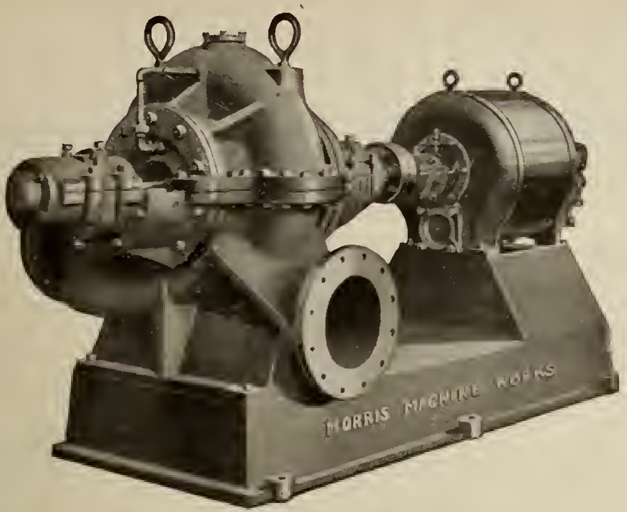


FEED WATER CIRCULATOR

THE PERMUTIT WATER TREATMENT

THE treatment of water for the removal of scale-forming impurities is a question which will engage the attention of power users as long as boilers and water are used for the generation of power. Various treatments have been evolved for the proper conditioning of feed water, most of us being familiar with the use of lime and soda, but the inability of the lime-soda process to remove magnesium salts has prevented complete satisfaction being obtained by this means.

At a recent lecture before the Newark, N.J. branch of the N.A.S.E., a description of the Permutit system was given in a lecture by S. B. Applebaum,* who said that Permutit was the trade name given to an artificially prepared mineral termed Zeolite, the natural forms of which belong to the group of hydrous silicates. The Zeolite having the greatest efficiency as a water softener, being at present manufactured from clay, feldspar, soda-ash and pearl-ash. The material resembles broken pebbles, but under the microscope is seen to be porous, exposing considerable surface



Accessible Pumps

The "Morris" Horizontally Split Shell Centrifugal Pump is very popular with pump users — can be inspected quickly without breaking pipe connections.

THE LATEST UP-TO-DATE DESIGN BACKED BY HALF A CENTURY'S PUMP EXPERIENCE

The cut shows a steam turbine driven pump, the same design being used for motor and other drives. We build centrifugal pumps for all services, including BOILER FEEDING, TANK PUMPING, GENERAL WATER SUPPLY, BRINE WORK, ETC. Send us your inquiries for pumps of all types.

STOREY PUMP & EQUIPMENT CO., KENT BUILDING, TORONTO, CAN.
Canadian Sales Agents for
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QUALITY

Is always present in

"AMERICAN" STEAM and POWER DRIVEN PUMPS

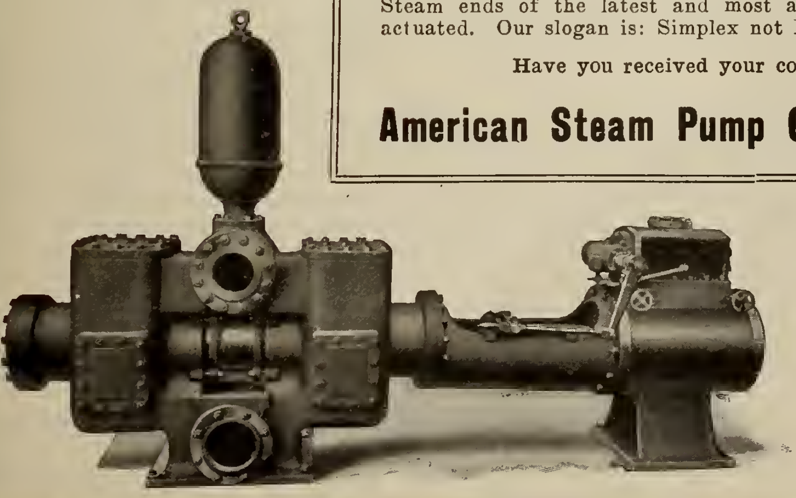
They are the result of over twenty-five years' experience in the design and construction of high-grade pumping machinery. Note the heavy, solid construction. Solid bronze piston rods and heavy cast bronze removable water cylinder bushings. Steam ends of the latest and most approved balanced piston type, mechanically actuated. Our slogan is: Simplex not Duplex, "To be simple is to be great."

Have you received your copy of our new Bulletin Catalog?

American Steam Pump Co., Battle Creek, Michigan

CANADIAN AGENTS:

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.



which facilitates the action of the substance on water.

The action by which the calcium and magnesium in the water is replaced by the sodium in the Permutit is one of exchange. As long as there is any available sodium left, so long will the process of exchange continue. When the sodium is exhausted, the material can be easily restored to its original condition by takes place in a very short time, a filter holding from 5 to 10 minutes supply is of ordinary materials. As the action salt used is a common grade costing soaking it with common brine. As a result of this treatment the calcium and magnesium, which were extracted from the raw water, are freed from the material and washed away, being replaced by the sodium from the brine, the process being termed "regeneration."

Owing to the insolubility of the material a great excess of the reagent can be used in the apparatus employed, so as to continue the reaction to a complete state, producing water of zero hardness without any indication of the reagent. The only possible action in the process is the exchange of hardness for sodium, and only sufficient sodium is given up by the material to complete this exchange. The softened water is thus kept free from causticity as occurs in the use about $4 per ton.

Trade Gossip

The Berlin Machine Works has changed its name to that of P. B. Yates Machine Co., Ltd.

William J. C. White, head of the firm of R. C. White & Co., engine and boiler makers, Montreal, died in that city on March 24.

The Canadian Ice Co.,Toronto, Ont., has been awarded a contract for installing a refrigeration plant by Smallman and Ingram of London, Ont.

The Chapman Valve Mfg. Co., of Indian Orchard, Mass., have opened an office at 727 Traders Bank Bldg., Toronto with A. R. Roberts as representative.

The Hare Engineering Co., Ltd., have recently received a contract to instal their Fulton water-cooled mechanical stokers in the new plant being built by the York Knitting Mills, Ltd., Toronto.

The William Hamilton Co., of Peterborough, Ont., have been awarded a contract for hydraulic equipment by the Portneuf Hydro Electric Co., of St. Albans, Que., for the new power plant.

Amherst, N. S.—The Ledcote Co., of Canada Ltd., has taken over a property here and is installing plant for covering sheets, etc., with lead as a substitute for galvanizing. William Knight is president of the concern.

The Bull Tractor Co., Winnipeg, Man., have taken over the plant of The Duty Engineer Works Co., Ltd., shipbuilders, Winnipeg, and will make tractors.

E. D. W. Courtice, assistant superintendent of the John street Pumping Station, city of Toronto, has resigned his position to enter the employ of the Hare Engineering Co., Ltd., as assistant engineer.

Sudbury, Ont.—The Sable River Mining Co., are installing a "Callow" 50-ton flotation plant at their property near Massey Station. The plant is for treating copper ores, and will have a capacity of 50 tons per day. J. F. Flynn is manager of the Company.

The Turbine Equipment Co., Toronto, Ont., have sold to the town of Mount Forest, Ont., a De Laval centrifugal pump having a capacity of one million Imperial gallons per day and to be operated by a 50 h.p. Canadian Westinghouse motor. This equipment will be installed in the waterworks pumping station.

Sherbrooke, Que.—A proposal is under consideration to develop power at Westbury Basin for an ultimate capacity of 5,400 h.p. at Westbury Basin switchboard and 5,000 h.p. at the switchboard at Sherbrooke substation. The cost of power equipment and erection would be $77,800 and for the complete development including excavation, buildings and transmission lines, etc., $305,567.

The Turbine Equipment Co., Ltd., Toronto, Ont., have been awarded a contract by the Board of Water Commissioners, Collingwood, Ont., to supply and instal two De Laval single stage centrifugal pumps, each having a capacity of 1,000 Imperial gallons a minute, against 165 feet head, and each direct-connected to a 75 h.p. Canadian Crocker-Wheeler motor, complete with valves, piping and venturi meter.

Steam and Air Motors.—The Dake Engine Co., Grand Haven, Mich., have issued an attractive catalogue describing an interesting line of steam and air motors, hoisting engines, stearing gears, capstans, windlasses, etc. The power-driven machinery dealt with in the catalogue is driven by the Dake square piston engine, which is fully described. Each type of machine is illustrated and featured, and the principal dimensions given for each size. The Dake marine line is dealt with in a separate section of the catalogue, and includes various types of power-driven deck machinery.

Catalogues

The York Mfg. Co., York Pa., have issued a bulletin dealing with the "York" enclosed refrigerating machine which is well adapted for markets, dairies, ice cream factories, etc. The bulletin is illustrated and the important features of the machine are briefly described.

The Marvin & Casler Co., Canastota, N.Y., have issued Catalogue E, dealing with the Casler offset boring heads and boring chucks. These appliances, which can be used on lathes and milling machines, are described fully, while illustrations show the various styles of boring heads and the method of mounting for various classes of work. The catalogue also includes specifications and prices for the boring heads, boring bars, cutters and tools.

Detroit Stokers is the title of an attractive catalogue being distributed by the Detroit Stoker Co., Detroit Mich., to feature the "Detroit" automatic mechanical stoker. Excellent illustrations show in detail the construction of this stoker and its principal features; its methods of operation are also described fully. Other illustrations of a similar quality show a large number of typical installations at various power plants. The "Detroit" stoker engine is illustrated and described and some useful efficiency tables etc., are included.

Fittings.—The Detroit Valve & Fittings Co., Detroit, Mich., have issued catalogue No. 3 to the trade. The piece list on straight size fittings has been revised and a piece list added on all reducing sizes. These lists are based on the estimated average weights of the fittings and so figured that piece fittings take a uniform discount. This list includes malleable iron fittings for steam, gas and water, drainage fittings and specialties also malleable and grey iron castings. The price lists are very complete and the catalogues fully illustrated.

Electric Pyrometers: — Catalogue No. 1400 deals with an interesting range of electric pyrometers made by The Wm. H. Bristol Co., Waterbury, Conn. The development of the "Bristol" pyrometer and general advantages of the thermo-electric systems are dealt with followed with a partial list of important applications. The various types of pyrometers, indicating switchboards, and scales are illustrated and described accompanied by price lists of all sizes and types. Particulars are given of thermo-couples with illustrations showing the method of application. The catalogue concludes with a partial list of users and illustrations showing a great variety of temperature measuring instruments manufactured by the company.

Potato Scale Powder Boiler Cleanser

Makes and Keeps Boilers New in Efficiency and Economy

You cannot afford to let scale accumulate in your boilers because it reduces their efficiency, which means a larger amount of fuel is needed to produce desired steam pressure.

Your boilers will be clean all the time if you use a small quantity of Potato-Scale Powder in your feed water daily—there will be no foaming, pitting or any other troubles due to impurities in the feed water. **Potato Scale Powder Boiler Cleanser** is made to suit your feed water conditions, and contains nothing injurious to tubes or fittings.

Sold under a positive guarantee. **Try a barrel.**

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384. P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 977.

EXACT KNOWLEDGE vs. GUESSWORK
Where Do You Stand?

All Modern Experience Points to the Absolute Necessity of Scientific Treatment of Boiler Feed Waters

Dearborn Treatment, by its remarkable results, has convinced the industrial world that the remedy for boiler feed water troubles lies in scientific analysis and special treatment for each individual case.

Dearborn Treatment is to ordinary "boiler compounds" what eminent, scientific diagnosis and prescription is to quack nostrums and "cure-alls."

Dearborn Treatment is based upon an expert, scientific analysis of a sample of the boiler feed water you are using. The analysis, tests and compounding of the correct remedy are conducted in the largest, most modern and elaborately equipped laboratories and manufacturing plant devoted to the science of water treatment in existence.

Dearborn Treatment gives you the benefit of the world's largest existing fund of data and experience relating to water treatment.

Dearborn Chemical Company of Canada, Limited
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Designer and builder of power and manufacturing plants, abattoirs, cold storage and packing house equipments. Factories constructed on the economy fire-proof plan. Ice-making plants and refrigeration installed.

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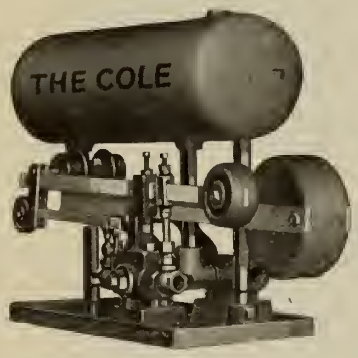


Mr. Engineer,

Let us give you a hand in running your plant EFFICIENTLY. What we have done for others, we can do for you.

Specify the COLE Steam Trap in your next budget. It returns condensation to boiler 100 degrees hotter than is possible with a pump and operates on 1-10th the steam that is required to run a steam pump—**the result is a big saving of fuel.**

Send us a pencil sketch of your plant, and we will show by blue print where your trouble lies, and how to stop it. **At least ask for booklet** which explains.

Geo. W. Cole Co.
838 Dundas St., Toronto, Ont.

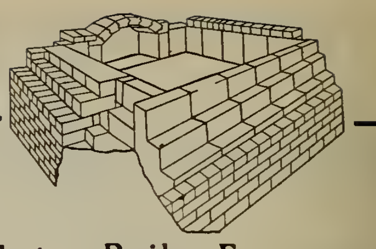
Homestead Valves.—A bulletin illustrating and describing various styles of valve made by the Homestead Valve Mfg. Co., Homestead, Pa. The essential points of these valves are dealt with fully particularly with regard to the quarter-turn feature of their construction.

Steam Saving Devices.—An interesting line of steam saving and protective devices are dealt with in catalogue No. 18 which is being distributed by The Strong, Carlisle & Hammond Co., Cleveland, Ohio. The specialties include steam and vacuum traps, separators, pump governors and pressure regulators, stop valves and engine stops, etc. Each appliance is described fully with special reference to its principal features. Sectional views are given showing the general construction and the method of operations is also described diagrams show some of the specialties installed and price lists with dimensions for the various sizes are included.

Book Review

Sampling and Analyzing Flue Gases is the title of bulletin No. 97, issued by the Bureau of Mines, Department of Interior, Washington, D.C. The bulletin by Henry Kreisinger, engineer, and F. K. Ovitz, assistant chemist, presents for the benefit of those in charge of boiler plants and all other persons interested detailed information on methods of sampling and analyzing flue gases, and on the utilization of the analyses in promoting boiler-room economy. This bulletin is intended to be a companion to Technical Paper 80, "Hand Firing Soft Coal Under Power-Plant Boilers," and is written in plain and non-technical language, as far as possible, so that it may be readily understood by persons who have not had the advantage of a technical education.

The material presented is arranged in two parts. The first part contains the description of the apparatus and the methods used in sampling and analyzing flue gases. The second part gives experimental results obtained with the different methods of sampling and collecting flue gas that are recommended in the first part of the report. Only simple apparatus and methods are considered, as they are accurate enough to show the large heat losses due to the use of too much air, and are also accurate enough to indicate any incomplete combustion losses of economic importance. Those who wish to obtain information on the more accurate methods of analysis of gases are referred to Bureau of Mines Bulletin 12, "Apparatus and Methods



Gates Boiler Furnace
Patent Applied For

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

—*WRITE FOR PARTICULARS.*—

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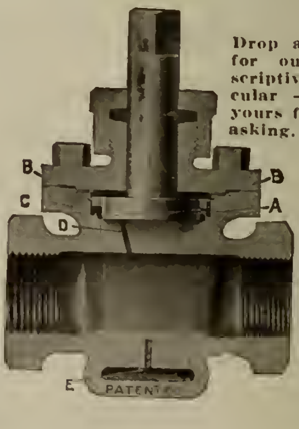
Montreal, Que.

How does your Valve Service compare with this?

One user says: "There are five Homestead Valves in our plant now for 13 years. When three of them were twelve years old I had them reground at a small expense, and I don't see why they should not last twelve years more; they are the regular 2" size and are opened every day in the year, and closed at 100 lbs. pressure and never fail to be tight."

"Homestead"
QUARTER TURN VALVES

Don't you think it wise to specify HOMESTEAD VALVES when placing your next order?



Drop a card for our descriptive circular — it's yours for the asking.

Homestead Valve Mfg. Co.
PITTSBURGH, PA.
Works: Homestead, Pa.

Classified Advertisements

WANTED

WANTED — DIRECT CURRENT MOTORS and generators. 110-250-500 Volt. Send detailed list to Box 189. The Power House. (5)

WANTED—FIRST-CLASS BOILER MAN TO take charge of battery of water tube boilers, 1200 H.P., which will be increased. Should be familiar with steam engine and air compressor. Reply, giving particulars of experience and salary expected. Box 190, Power House, Toronto. (4)

FOR SALE

FOR SALE—TWO HORIZONTAL RETURN tubular boilers 60" x 16', built to comply with Ontario Government specifications. Made in St. Catharines for a special order. Full particulars and details upon application to Taylor-Forbes Co., Ltd., Guelph, or Taylor-Forbes Co., 1088 King Street West. Toronto.

THE PROPRIETORS OF LETTERS PATent No. 127080 relating to "Process of Manufacturing Iron Electrodes for use in Alkaline Accumulators" and No. 127081 relating to "Active Masses for Positive Electrodes of Electric Elements, etc.," desire to dispose of the Patents or to grant Licenses to interested parties at reasonable terms with a view to the adequate working of the Patents in Canada. Inquiries to be addressed to the actual proprietors, Svenska Ackumulator Aktiebolaget Jungner, Stockholm, Sweden.

USED POWER EQUIPMENT.

ENGINES.

75 H.P., 16 x 36 Leonard Corliss, used less than year; heavy duty type.
85 H.P., 13 x 30 Brown automatic, excellent condition.
75 H.P., 12 x 30 Inglis Corliss
75 H.P., 12 x 12 Robb high-speed.
20 H.P. Robb high-speed.

BOILERS.

72 x 18 horizontal return tubular, shaking grates, Government inspected.

GENERATORS AND MOTORS.

200—300-light dynamos.
20, 25, 35, 250-volt motors.
50 H.P. gas engine and producer, good as new, at great bargain.
Hobbs & McGill, Mail Building, Toronto, Ont.

Electric Power Engines and Generators for Sale

1—Engine — H.P., 500; stroke, 24; bore, 22; generator; capacity 300 K.W.; 545 Amps.; 500 volts; Speed 150 R.P.M.

2—Engine — H.P., 320; stroke, 18; bore, 17; generator; capacity, 200 K.W.; 365 Amps.; 500 volts; speed 200 R.P.M.

All in good condition.

Apply

Box 192, The Power House

for the Sampling and Analysis of Furnace Gases,'' and Technical Paper 31, ''Apparatus for the Exact Analysis of Flue Gas,'' which may be obtained from the Superintendent of Documents Government Printing Office, Washington, D. C., at a cost of five cents each. Bulletin 97 may be obtained by addressing the Director of the Bureau of Mines, Washington, D.C.

Heaton's Annual.—The twelfth edition of Heaton's Annual published by Heaton's Agency, Toronto, has pust appeared. There has this year been developed a section aptly entitled ''Where to Find It.'' This is practically an index to the more important contents of the Dominion and Provincial Government Reports and Standard Publications relating to Canada. Every business man some time in the year says to himself: ''Where can I find it?'' and often spends days to find out. On the other hand, the Dominion and Provincial Governments annually spend hundreds of thousands of dollars in burying information alive in books and pamphlets, of which the general public never hear. Indeed very few people know of the valuable and interesting information which can be had for the asking. By referring to this section, the reader can at once put his finger upon the information which he wants and find the publications which contain it and the department to whom application must be made. As in previous years, the Annual contains official, bank, insurance, and legal directories, postal information, cable rates, the complete Customs tariff revised to date; a shipper's guide (covering every commercial town in Canada and giving the population, railways and banks), list of registry offices for deeds, chattel mortgages, etc.; up-to-date descriptions of every town in Canada, exchange and miscellaneous tables, and a mass of valuable general information, from which cross references are given to the section ''Where to Find It'' for the benefit of those who want further information. It would be difficult to imagine a book which fills its mission more completely than Heaton's Annual.

Fetherstonhaugh & Co.

Patents Trade Marks and Designs in all countries

Canada Life Bldg., MONTREAL

U.S. METAL POLISH

Works Equally Well on Hot and Cold Surfaces. It Cannot Blow Up. Cleans, Polishes and Preserves all kinds of metals.

Tear this off as a reminder

Geo. Wm. Hoffman Co.,
557 E. Wash. St.
Indianapolis, Ind.

Enclosed find 10c in stamps, for which send me one large 50c can of U. S. Metal Polish Paste.

Name ....
Address ....
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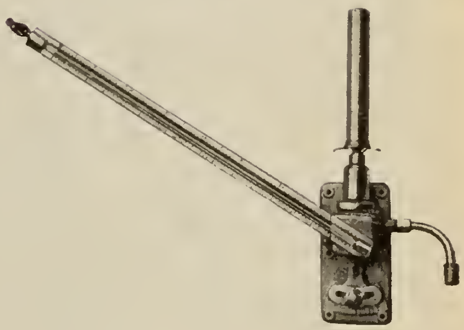
Universal LIQUID MEASURING Devices



THE above cut is simply one of many types of measuring instruments, and we will be glad to supply instruments covering any class of liquid measuring on receipt of the following data:

1. S.P.G. of Liquid to be measured.
2. Depth of container.
3. Approximate location of container from Instrument.
4. Scale per foot of depth required on the instrument.
5. Maximum and minimum depths of liquid to be measured.
6. Whether the tank is exposed to frost.
7. Whether tank is vented.

On receiving information we will advise on best type of instrument.

This instrument measures the quantity of water or other liquid in a tank, well, stream or in almost any situation, and is absolutely free from mechanical devices, except for a small air pump at the instrument itself.

ALWAYS READY, ALWAYS SURE — ALWAYS KEEPS YOU POSTED ON THE QUANTITY OF LIQUID ON HAND, SAVES MUCH TIME AND PREVENTS "RUNNING SHORT."

Can be placed close to or far away from the liquid. It does not matter where the liquid to be measured is in relation to the device, as all you have to do is to run a piece of ¼ in. pipe from the tank to the instrument and the tank may be below or above ground, or hundreds of feet from the instrument, which latter is placed at any convenient position in the office or desired room.

Drop a line for circular and full particulars.

UNIVERSAL MEASURING DEVICES, Limited

125 ISABELLA STREET, TORONTO

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

To Manufacturers, Dealers and Users of Steam Boilers

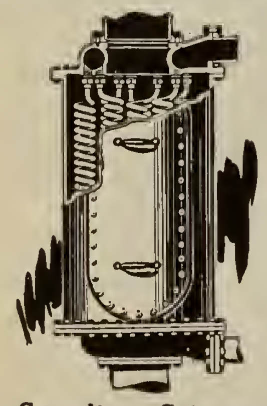
All steam boilers built in, or entering the Province of Ontario, and boilers exchanged or repaired are subject to Government Inspection as prescribed in the Steam Boilers Act, 3 George V., C. 61.

Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department, stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the Regulations by an Inspector authorized under the Act.

All communications should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G. MACDIARMID,
Minister of Public Works.

D. M. MEDCALF,
Chief Inspector of
Steam Boilers.

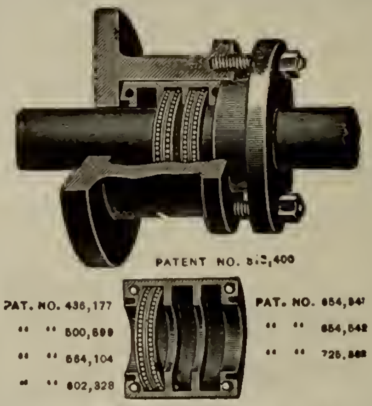


Reilly Multicoil Feed Water Heater

Has greater capacity per square foot of heating surface than any other type of closed heater. It is simple in construction, light in weight and small in size.

Write for Bulletin No. 210.

Canadian Griscom-Russell Co., Ltd.
960 St. Paul Street, Montreal, Quebec



Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.

NOTICE

TO

Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. JAS. S. DUFF,
MINISTER OF AGRICULTURE.

W. C. McGHIE,
CHAIRMAN OF BOARD.

Water Turbines, Hydraulic Governors, Centrifugal Pumps

OUR LINDSAY WORKS

Boving Hydraulic & Engineering Co., Limited
LINDSAY, ONTARIO

McDANIEL IMPROVED STEAM TRAP

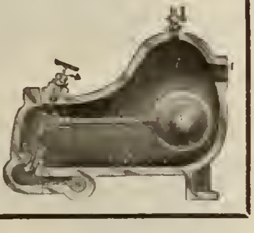
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

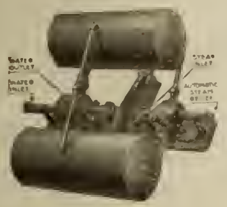
MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.
WATSON & McDANIEL CO.
No. 146 N. 7th Street, PHILADELPHIA, Pa



Write for Bulletin

Canadian Duplex Steam Trap Co.

Walkerville Ont.

CANADIAN DUPLEX

Return Steam Trap

THE MILNE VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.

Owners and manufacturers for the United States.

Write for Bulletin No. 16.

Advertising is an insurance policy against forgetfulness. Stopping an advertisement to save money is like stopping a clock to save time—it compels people to think of you—Galveston News.

Scandinavia Belting

This is the original solid woven belt. There are no plies to come apart. If you wish to save money in your plant use this belt.

Federal Engineering Co., Limited
TORONTO. MONTREAL.

DARLINGS STEAM APPLIANCES

DARLING BROTHERS
LIMITED
Engineers and Manufacturers
MONTREAL, CANADA

Branches: Toronto and Winnipeg

Agents: Halifax, St. John, Calgary, Vancouver

ENGINEERS???

HOW ARE YOU ON ELECTRICITY?

If you desire a complete practical working knowledge, you can easily get it from **"HAWKINS ELECTRICAL GUIDES"**—all points covered by questions, answers and illustrations, **easy to learn and remember.** Get the best information you can on Electrical Engineering. It is the coming power, and to keep up with the times you must be a good electrician as well as good on steam practice. These guides fill the bill—let them post you up. If you learn more you will earn more. Act now, today—no risk offer to look this course over yourself. They all say it is good—why not be in the front row? Delay is dangerous, look over the books at Audel's expense. No money down until you are satisfied. Free examination. Sign, stamp and mail coupon today and be prepared for your chance—the man best informed **WINS OUT.**

HAWKINS ELECTRICAL GUIDE No 10 WITH QUESTIONS ANSWERS AND ILLUSTRATIONS

They are not only the best, but the cheapest works ever published on Electricity. The books are sold at $1 each. They are guaranteed in every way or your money will be returned. The numbers will be supplied separately when desired for $1 each. 8 numbers now ready.

Containing the principles of Elementary Electricity, Magnetism, Induction, Experiments, Dynamos, Electric Machinery.—The construction of Dynamos, Motors, Armatures, Armature Windings, Installing of Dynamos.—Electrical Instruments, Testing Practical Management of Dynamos and Motors.—Distribution Systems, Wiring, Wiring Diagrams, Sign Flashers, Storage Batteries.—Principles of Alternating Currents and Alternators.—Alternating Current Motors, Transformers, Converters, Rectifiers.—Alternating Current Systems, Current Breakers, Measuring Instruments.—Alternating Current Switch Boards, Wiring, Power Stations, Installation and Operation.—Telephone, Telegraph, Wireless, Bells, Lighting, Railways, and Modern Practical Applications of Electricity.

FREE EXAMINATION OFFER

Theo. Audel & Co., 72 5th Ave., New York

Please submit me for examination HAWKINS ELECTRICAL GUIDES (Price $1 each.)

Ship at once, prepaid the first eight numbers; if satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature....................................

Occupation....................................

Business Address....................................

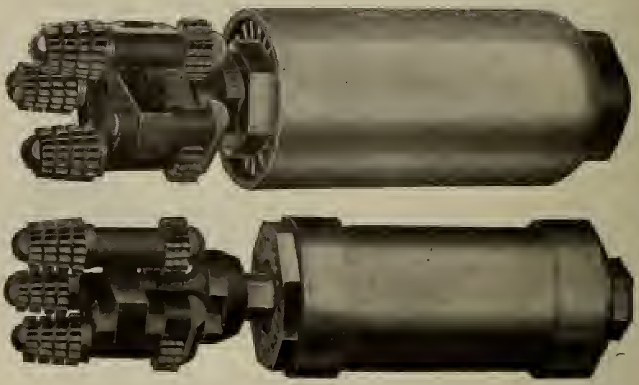
Residence....................................

If any advertisement interests you, tear it out now and place with letters to be answered.

BABCOCK & WILCOX LIMITED

LAGONDA

BOILER TUBE CLEANERS



The latest Lagonda Water and Air-Driven Boiler Tube Cleaners are the most powerful and efficient tube cleaners made. They develop higher speed and greater power than has heretofore been secured with any Turbine Cleaner, and their use will materially shorten the time required in cleaning boilers.

These new Lagonda Cleaners are built for all sizes of tubes, either straight or curved, and they can be driven by water, air or steam.

Ask for Catalog L-8.

LAGONDA Multiple Water Strainers

The Lagonda Multiple Water Strainer in your water supply main will remove all objectionable solid matter and insure constant and economic conditions of pump and condenser operation. They are easily and quickly cleaned, without interruption of water supply, and take up small floor space. **Ask for Catalog R-2.**

BABCOCK & WILCOX LIMITED

St. Henry, MONTREAL
Branch Office: Traders Bank Building, Toronto

MacKinnon, Holmes & Company, LTD

SHERBROOKE, QUE.

We build-

COAL BUNKERS
OIL TANKS
WATER TANKS
AIR RECEIVERS

and miscellaneous plate and structural work of every description used in connection with power plants.

GENUINE
ARMSTRONG STOCKS AND DIES
MALLEABLE IRON HINGED PIPE VISES, PIPE CUTTERS, PIPE MACHINES.
MANUFACTURED BY
THE ARMSTRONG MFG. CO.
298 KNOWLTON STREET
BRIDGEPORT, CONN.
NEW YORK: 248 CANAL STREET

You are familiar with the action of ordinary brushes—grinding, sparking, screeching and kindred annoyances.

DIXON'S GRAPHITE BRUSHES

overcome all these troubles. Perhaps they are just what you need. Why not write for data sheets and booklet No. 222-M now?

Made in JERSEY CITY, N.J., by the

JOSEPH DIXON CRUCIBLE COMPANY

Established 1827

M-22

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

THE POWER HOUSE BUYERS' DIRECTORY

To Our Readers—Use this directory when seeking to buy power equipment or supplies. You will often get information that will save you money.

To Our Advertisers—Send in your name for insertion under the heading of the lines you make or sell.

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Canadian Fairbanks-Morse Co., Ltd., Montreal.
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MacKinnon, Holmes & Co., Sherbrooke, Que.
Smart-Turner Machine Co., Ltd., Hamilton.

AIR RECEIVERS
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Frick Co., Waynesboro, Franklin Co., Pa.

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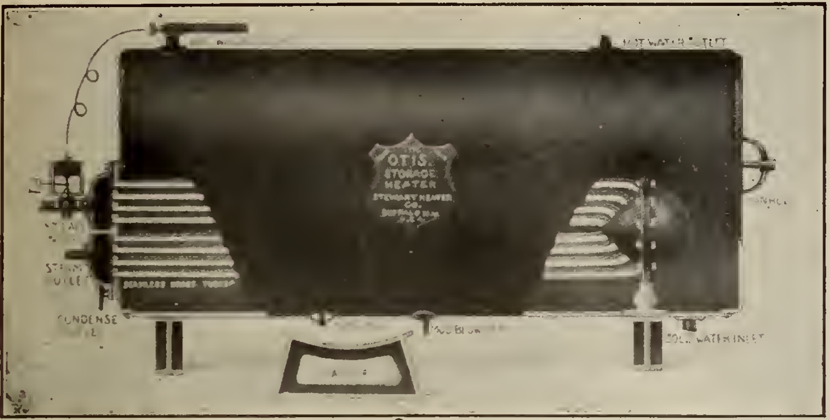

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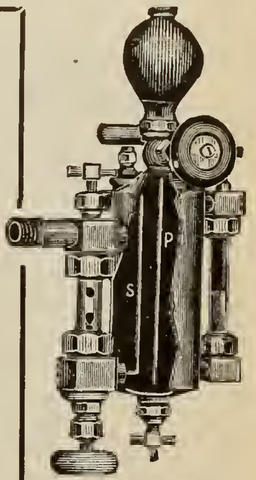

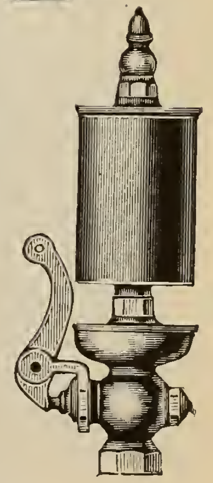

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Lunkenheimer Co., Cincinnati, O.

LUBRICATORS, PLAIN
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Can. Detroit Lubricator Co., Walkerville, Ont.
Hamilton Brass Mfg. Co., Hamilton, Ont.
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Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Detroit Stoker Co., Detroit.
Hare Engineering Co., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

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Hamilton Brass Mfg. Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

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Lunkenheimer Co., Cincinnati, O.

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Canadian Griscom-Russell Co., Ltd., Montreal.
Geo. W. Cole Co., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
C. A. Dunham Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
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Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
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C. C. Snowdon, Calgary.

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Can. H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

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Can. H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

PACKING, METALLIC
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

PACKING, ROD
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.
Steel Mill Packing Co., Windsor, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

PACKING, SHEET
Garlock Packing Co., Hamilton, Ont.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Jenkins Bros., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

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Greene, Tweed & Co., New York.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

PACKING, LEATHER
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Graton & Knight Mfg. Co., Montreal.

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MacKinnon, Holmes & Co., Sherbrooke, Que.

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Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

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Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

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Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

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Can. Sirocco Co., Windsor, Ont.

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Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Wm. Hamilton Co., Ltd., Peterborough, Ont.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
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Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

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Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.
Waterous Engine Works Co., Brantford.

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Smart-Turner Machine Co., Hamilton, Ont.
Terry Steam Turbine Co., Hartford, Conn.

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Smart-Turner Machine Co., Hamilton, Ont.
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Storey Pump & Equipment Co., Ltd., Toronto.
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Smart-Turner Machine Co., Ltd., Hamilton.
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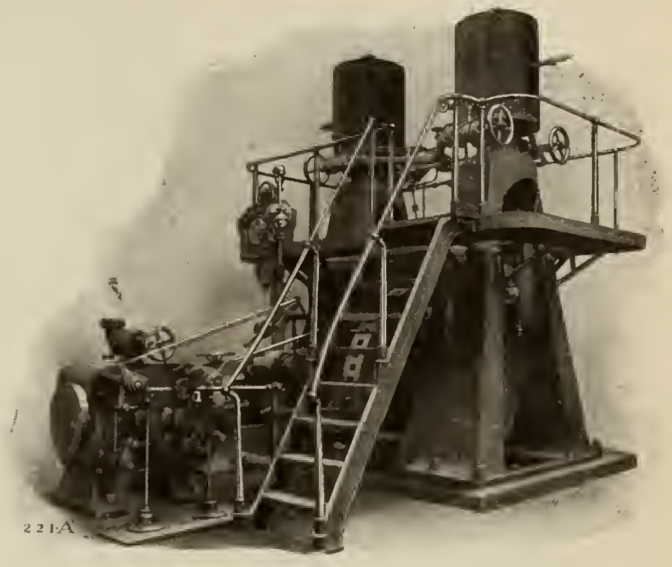

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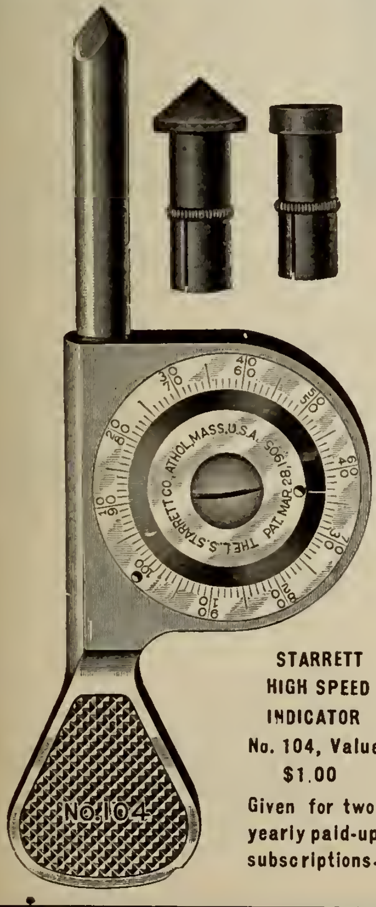

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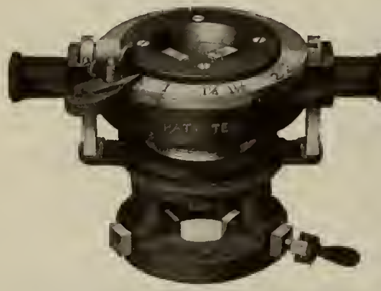

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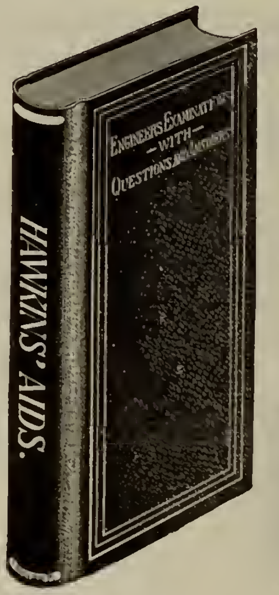

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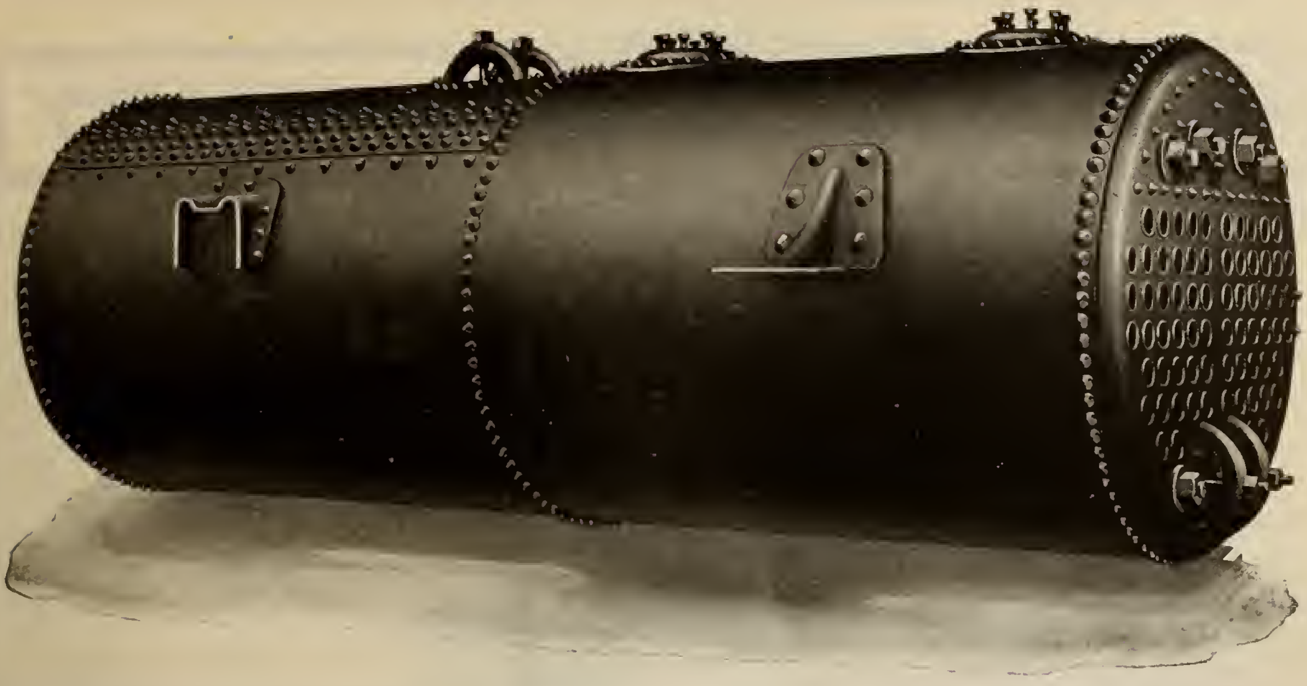

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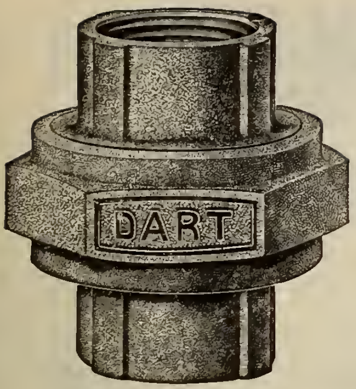

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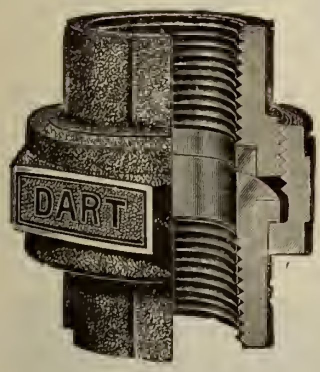

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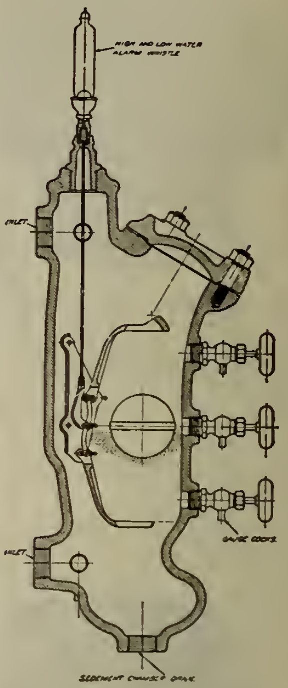

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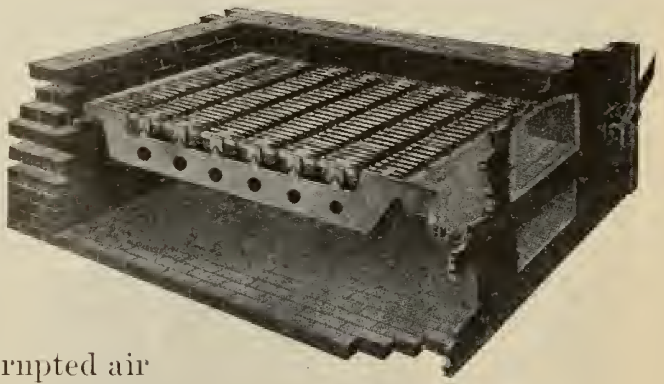

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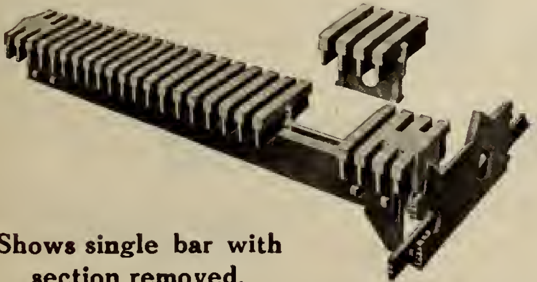

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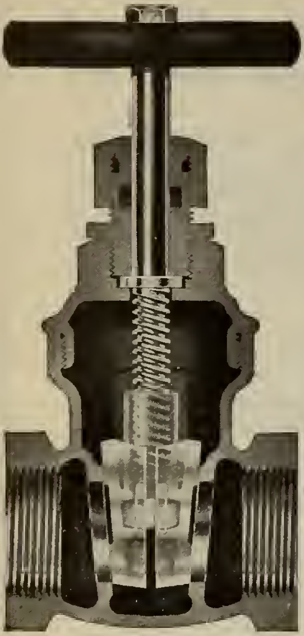

SECTIONAL VIEW
Fig. 300

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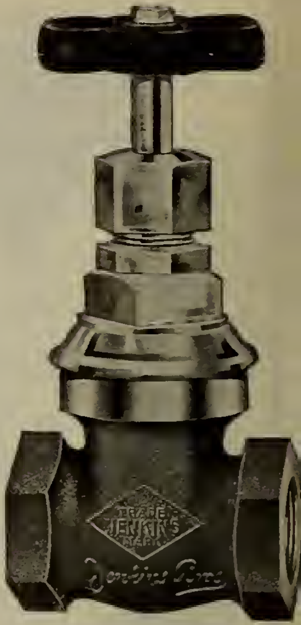
MARK



OUTSIDE VIEW
Fig. 300

Jenkins Bros

THESE valves are very carefully designed: the metal is equally distributed, and they have great strength. In the construction of the discs is employed a combination of the solid wedge and the split wedge principles, producing a mechanism which is unequalled for ease of operation and perfect closing. The discs are carried on a spindle-nut, so constructed as to act as a wedge at the point of closing, and at the same time allowing a certain amount of flexibility—permitting the discs to seat perfectly, even should there be a slight derangement of the angle of the seats. Unlike the solid wedge type, the discs cannot jam in the valve body, for the first movement of the spindle loosens the discs, and the guides in the body remove them from the seat faces.

STOCKED BY DEALERS EVERYWHERE

BE SURE THAT THE VALVES YOU BUY HAVE THE DIAMOND TRADE MARK CAST ON BODY —IT IS PUT THERE FOR YOUR PROTECTION.—

Write for Catalogue No. 8.

JENKINS BROS., Limited

103 St. Remi Street Montreal

UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER

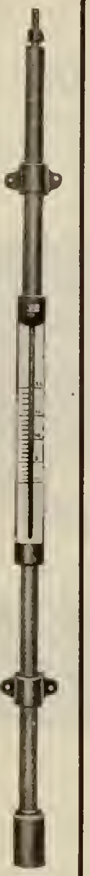
Record of CO2 and stack temperature on one chart.

Does your fireman know how much fuel he is wasting? Do you know?

The **Uehling** CO_2 **Recorder** makes a complete 24 hr. record of your combustion efficiency and the **CO2 indicator at the Boiler Front** holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.



CO2 Indicator for Boiler Front

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

2008 Empire Building New York City

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

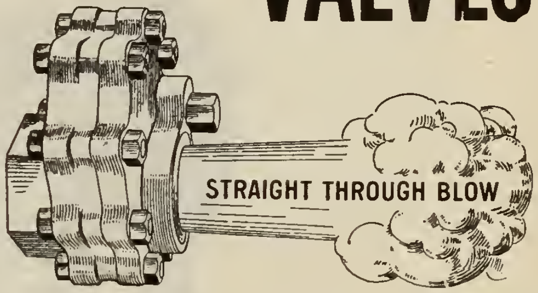
Mason Regulator Company

BOSTON, MASS.

CANADIAN AGENTS

H. L. PEILER & CO., MONTREAL and TORONTO

EVERLASTING Blow-Off VALVES



"EVERLASTING" Blow-Off Valves will immediately end your blow-off leaks or troubles.

No Packing.

No Stuffing Box.

Self-Grinding Seat.

Self-Cleaning.

—NOTHING TO GET OUT OF ORDER.

Over 220,000 in use

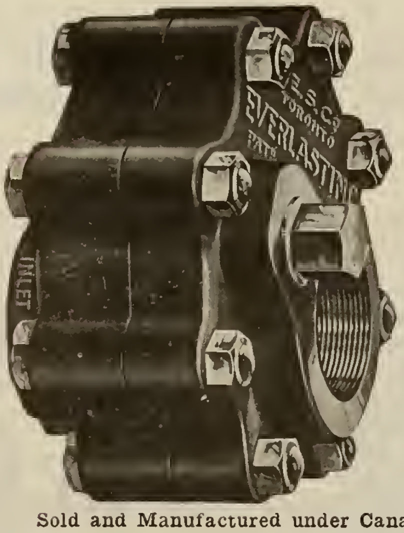
The *Everlasting Valve*—endorsed by leading Consulting Stationary and Marine Engineers.

Accepted by Boiler Inspection Insurance Companies.

Approved by all Provincial Governments requiring High Pressure Valves and Accessories to be registered and recorded. Provincial Record Numbers furnished on request.

OUR GUARANTEE—Satisfaction guaranteed or money refunded within one year.

Not guaranteed against galvanic action or corrosive acid.



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Look for this ☞MARK

The word "EVERLASTING" is on every genuine "EVERLASTING" Blow-Off Valve — it's your safeguard against imitations.

Sold and Manufactured under Canadian Patents by

ENGINEERING SPECIALTIES COMPANY, Limited

1080 King St. West, Toronto

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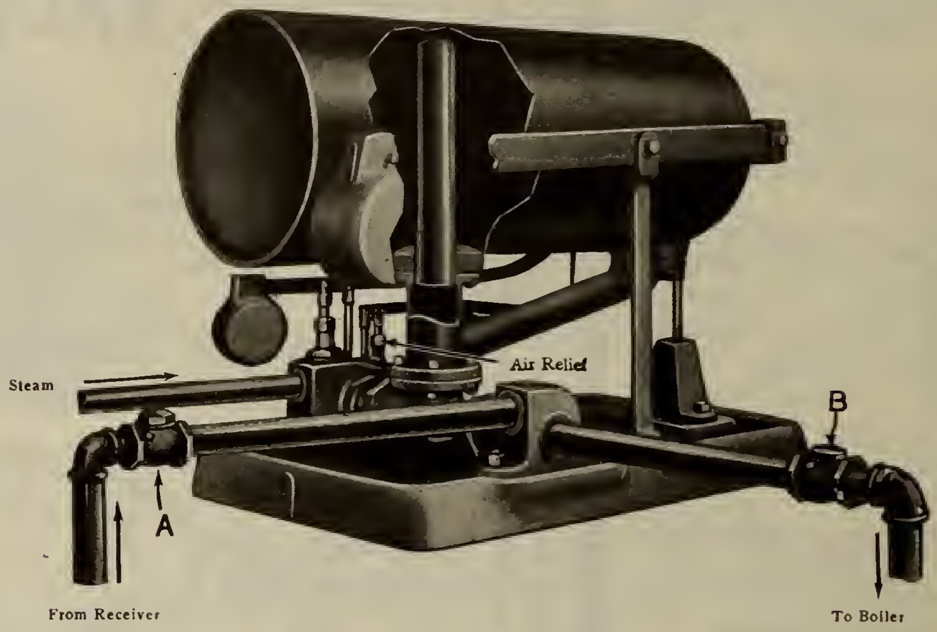
Nothing Mysterious about a Detroit Trap Every Working Part is on the Outside



"Detroit" STEAM TRAPS

Some Facts You Should Know About Them

1. Nothing inside the tank to rust, corrode or give trouble—all working parts are on the outside and interchangeable.
2. Large water-handling capacities for space required. Will handle water at a higher temperature than a pump will lift.
3. Properly constructed — properly assembled and thoroughly tested before shipment.
4. Increase efficiency of steam coils or steam-heated machinery by keeping all lines free and clear of condensation.

These are only four of the reasons why "Detroit" Traps save money for the user. Trap catalogue No. 352 gives all information—capacities—sizes, etc. Write the home office or any sales office.

CANADIAN Sirocco COMPANY
LIMITED
WINDSOR, ONTARIO.

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LUNKENHEIMER
Cast Steel Valves

High pressure superheated steam is universally acknowledged the basis for efficiency and economy in the operation of large steam units.

The increase in pressure and temperature over the ordinary conditions of operation necessitates the use of valves having the greatest strength and wear-resistance.

Lunkenheimer Cast Steel Valves are built especially for severe operating conditions. The cast steel used has a tensile strength of about 80,000 pounds, with a safe elastic limit and excellent elongation. It contains less than .05 per cent. of either phosphorus or sulphur, elements which are detrimental to strength. Castings are free from defects; they are annealed to relieve internal stress and have the fine grained structure so essential to strong steel.

The materials used for the trimmings are especially adapted for high pressures and temperatures—the composition varying according to the degree of superheat.

Excellent design and Lunkenheimer "Quality" workmanship in addition to the high grade materials, insures the user most efficient service.

Globe, Angle, Gate, Non-return Safety Boiler Stop, etc., for working steam pressures up to 350 pounds and temperatures to 800° Fahrenheit.

Buy the best—they are the cheapest.

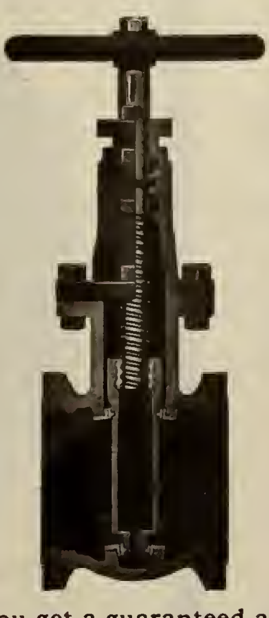
Write for catalog No. 50.

THE LUNKENHEIMER CO.
"QUALITY"
Largest Manufacturers of
High-Grade Engineering Specialties
in the World
CINCINNATI, O., U.S.A.

New York Chicago Boston London
15-7-43

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

If any advertisement interests you, tear it out now and place with letters to be answered.

OSTER
Bulldog
Die-stock

MADE
IN 11
HANDY
SIZES

OSTER TOOLS

There's an Oster Tool that fits your particular needs

In the Oster line there is a die-stock, a tripod tool, a bench tool, a belt-driven machine or a motor-driven machine that threads just the combination of pipe sizes you need—47 different tools in all, backed by twenty-five years' experience. If you need pipe-threading done you want Oster-Cut Threads. Ask for catalog and names of Canadian dealers. *You will be surprised to find how exactly we can fit your requirements.* Write

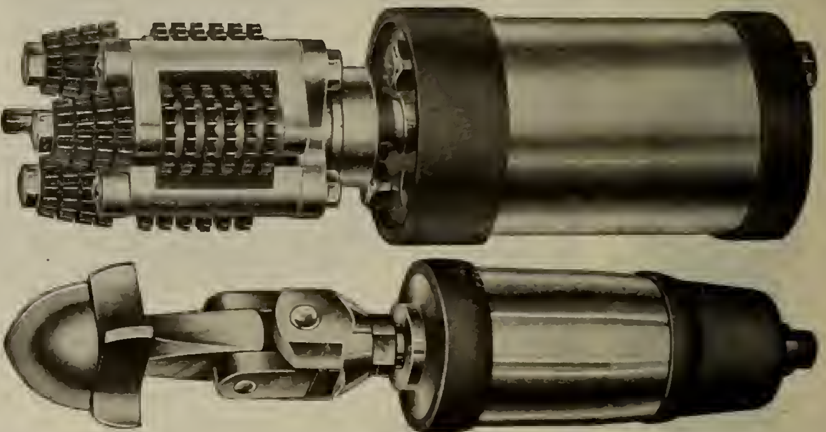
The Oster Mfg. Co.
2099 E. 61st Street, - - CLEVELAND, OHIO

ROTO TUBE CLEANERS

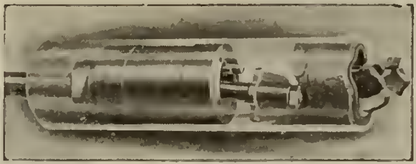
Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.
The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.

THE ROTO COMPANY
Write for Catalog HARTFORD, CONN.



SIX POINTS——



The Dean Boiler Tube Cleaner operating in and removing scale from the tube of a water-tube boiler. Note how the Dean vibrates back of the scale, thus forcing it to break up clean down to the metal.

In Favor of the DEAN

1. The Dean Cleaner is the only tube cleaner made that COMPLETELY removes the scale from all types of boilers—neither turbining nor compounds do it. Ask Mr. Farrow, C.E., of the Gold Medal Furniture Co., Toronto.

2. The Dean Cleaner is adaptable to both water-tube and fire-tube boilers, interchangeably, thus making one Cleaner do the work of two. This means a big saving in first cost.

3. The Dean Cleaner is flexible, so that the same mechanism may be used, with different sizes of tubes. Another big saving!

4. The Dean Cleaner has proven its ability to take out scale faster and more thoroughly than any other type of tube cleaner.

5. The Dean Cleaner's simple construction and sturdy solidity make for long life and low upkeep cost.

6. The Dean Cleaner is sold under the most liberal trial terms, with special service to users, and a broad, generous guarantee.

Dean

Write for details of Point No. 6. Ask particularly for Booklet No. 139.

The William B. Pierce Co.
153 Ellicott St. 201-2 Coristine Bldg.
uffalo, N. Y. Montreal, Quebec.
Winnipeg Representative: W. W. Hicks, 567 Banning Street

III IMPORTANT THINGS

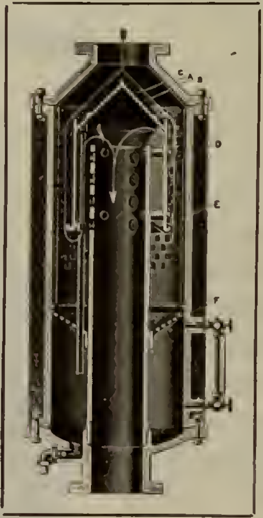
TO CONSIDER ABOUT
A SEPARATOR.

I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

SWEET'S SEPARATORS.



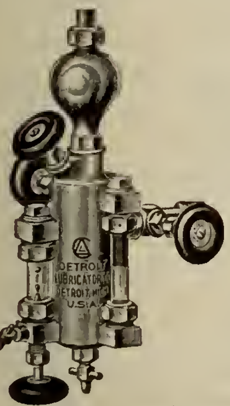
DIRECT SEPARATOR COMPANY
820 Geddes Street - SYRACUSE, N. Y.

General Sales Agents:
Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Vancouver, Victoria.

Insist on "Genuine Detroit" Lubricators

Since 1867 the Detroit Lubricator Company has maintained the leadership in the manufacture of an efficient lubricating device for every purpose.

Over half the lubricators in the world are Detroits, and this demand for "Genuine Detroit" Lubricators is the demand for *quality.*


DETROIT LUBRICATOR DETROIT, MICH. U.S.A.

Naturally a product with the reputation of the Detroit has many imitators—some of the imitations being sold on the strength of looking like the Detroit and some as being "just as good as the Detroit."

For your protection we mark every package with the above trade-mark—look for it and see that you get the genuine.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

Largest manufacturers of lubricating devices in the world

ALBANY GREASE

will show wonderful lubricating results on engines, motors, pumps, compressors, line shafting and all other kinds of machinery at all times. Albany Grease can be used in any kind or style of grease cup and will not cake or clog the cup. It will not leak or run away. No matter what kind of machinery you have, Albany Grease will lubricate it perfectly. Why not try Albany Grease at our expense? We'll send a quantity and a cup if you will write.

Your dealer sells Albany Grease; if not, order direct

Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868

Why continue to allow Boiler Scale Troubles to disturb your Peace of Mind when we offer you a GUARANTEED TREATMENT—one that has been endorsed by over 25,000 Progressive Engineers.

Perolin
MADE IN CANADA

Boiler Metal Treatment

will remove and prevent scale formation regardless of the present condition of your boilers or the source of feed water supply.

IT DOES NOT TREAT THE FEED WATER—IT TREATS THE BOILER METAL. Loosens scale mechanically, so that it can be washed out.

When scale has been removed Perolin fills the pores of the Metal, forming a smooth surface to which scale-forming sediment cannot adhere so long as this film is maintained.

To maintain this film permanently, only a small amount of Perolin is required to be fed each day.

Send for our trial proposition, which puts the burden of responsibility up to us.

PEROLIN COMPANY OF CANADA, LIMITED
Office and Factory: 858 Dupont Street, TORONTO, ONTARIO

WESTERN AGENTS: Canadian Sarco Engineering Co., Limited, 1206 McArthur Bldg., Winnipeg, Man. Western Supply & Equipment Co., Limited, Calgary, Alta. Bayfield & Archibald, 334 Seymour St., Vancouver, B.C.

FOR SAW MILLS

FROST-SIBLEY LUMBER CO.,
Lamison, Ala., 4-24-15

Gentlemen:

We are in receipt of your letter of the 17th, and will advise that Magnolia Metal hardly needs introduction with us, as we have used same very satisfactorily indeed, ever since we have been in operation at this point. Magnolia Metal has long been "Standard" with all the men connected with our business, both at the present operation and at other mills that the members of this firm have been interested in. We might state that as long as you continue to place a product of such recognized merit on the market, we will continue to use same.

With kindest regards, we remain,

Yours very truly,

FROST-SIBLEY LUMBER COMPANY.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c. post paid.

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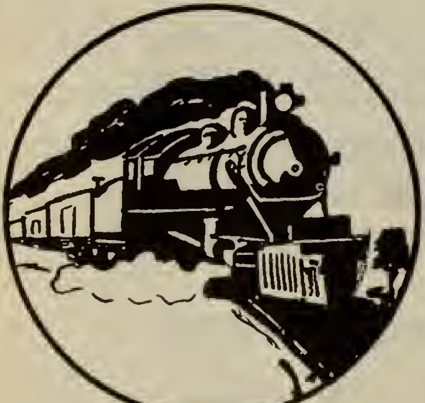


Sliptivity Steam Cylinder
Sliptivity Steam Engine
Automobile Cylinder

OILS

These highly efficient lubricants go a long way and will greatly add to the life of your machinery.

They are a triple combination that's hard to equal. A trial will convince you of this fact and create a desire for more.

USED OVER THE ENTIRE WORLD.

Our prices are very reasonable for that of good quality.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1964. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384, P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 877.

BOWSER
ESTABLISHED 1885

Lubricating and Oil Filtering Systems

F-1

are being installed in the newest and finest power plants in the country, because they are an essential part of modern equipment. They also prove their efficiency in older plants even more readily.

We manufacture central or individual oil clarifying devices, with capacities from 5 gallons to 7,000 gallons—or even more—of filtered oil per day.

Put Your Oil Handling Problems up to us

Our Engineering Department is acknowledged as the foremost authority on subjects pertaining to the storing and handling of oils of all kinds. We will lay out and install a complete Oil Filtration System and turn it over to you in service; or we will furnish you an individual outfit; or the filter only; or each system complete with instructions how to erect it.

Bowser Systems were awarded the Grand Prize and Gold Medal at the Panama-Pacific Exposition, San Francisco, Cal., 1915.

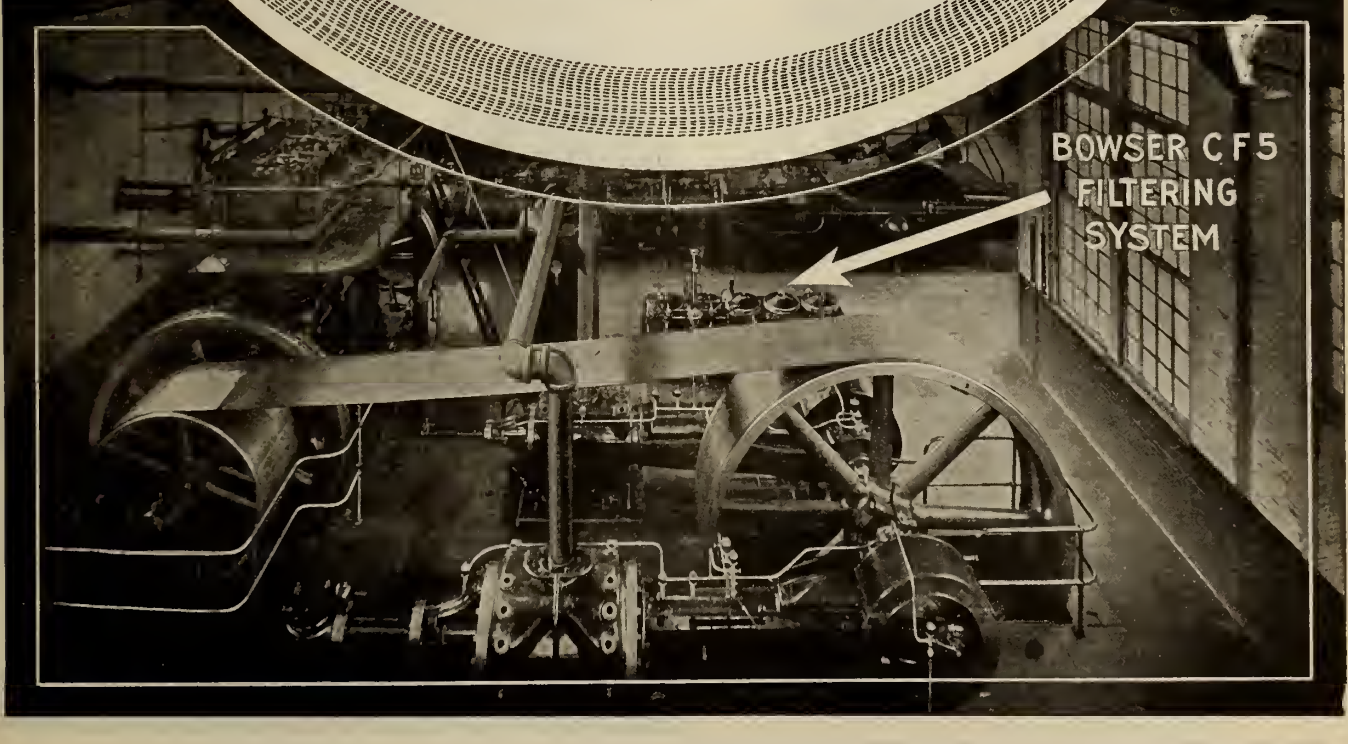
An inquiry for descriptive matter and information on anything along this line will not obligate you in the least.

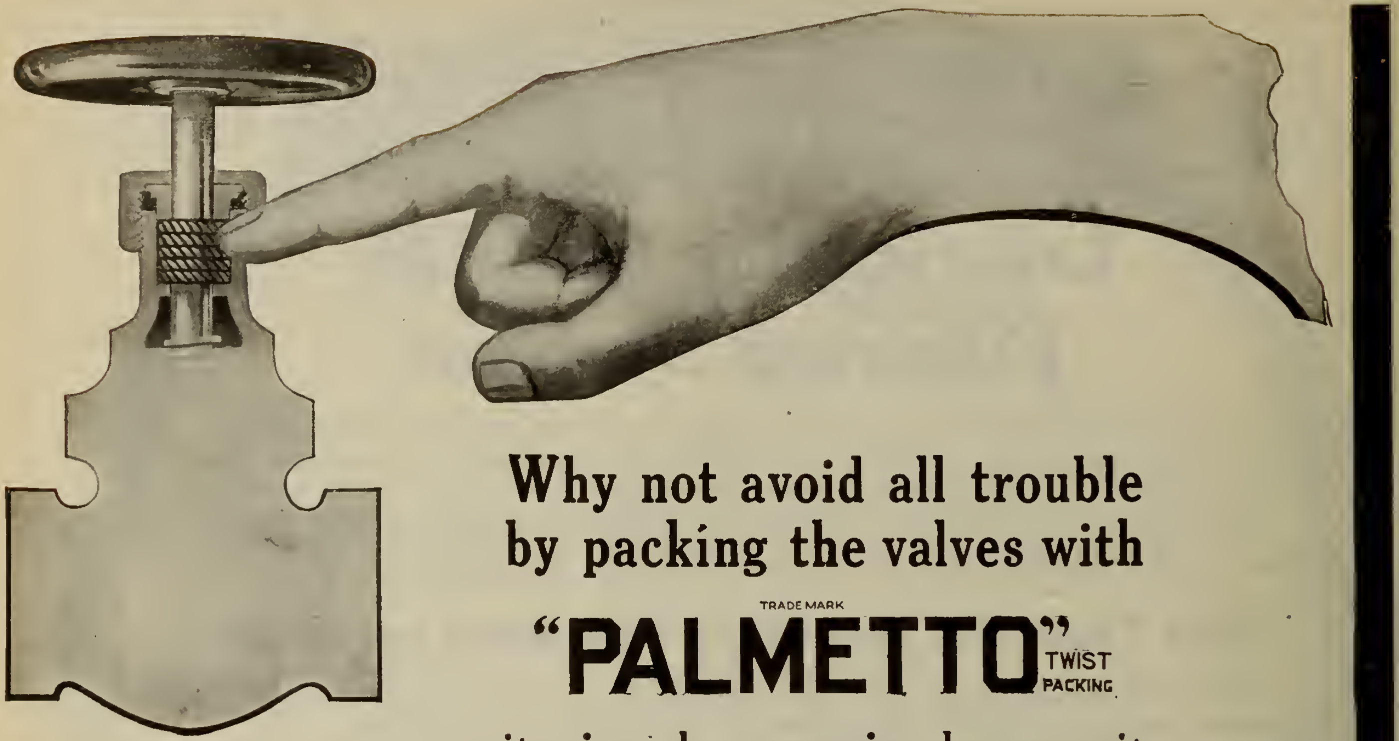
S. F. BOWSER & COMPANY, Inc.

Engineers, Manufacturers and Original Patentees
of Oil Handling Devices

Frazer Avenue, TORONTO, ONT.

Sales Offices in all Centers and Representatives
Everywhere





Why not avoid all trouble by packing the valves with

TRADE MARK
"PALMETTO" TWIST PACKING

it gives long service because it has lubricant in each strand.

Let us send you a Sample Spool of "Palmetto" Twist.
It will prove its worth to you.

Any size valve packed from one spool by unstranding.

GREENE, TWEED & CO.
SOLE MANUFACTURERS
109 Duane Street New York

Canadian Distributing Agents:
The CANADIAN FAIRBANKS-MORSE CO., LIMITED
Montreal, Ottawa, St. John, Toronto, Winnipeg,
Calgary, Saskatoon, Victoria, Vancouver

You Can Quit When the Others Do

Tens of thousands of engineers have been freed from night and Sunday work repacking leaky, blowing stuffing-boxes that ordinary rod packings cannot hold steam-tight.

"You can quit when the others do," and like the rest of the workers in your plant, you can have your evenings and Sundays to yourself for the enjoyment of home life, pleasure trips with your family or other recreation, if you'll just use—

DANIEL'S ROD PACKING

P.P.P.

FOR STEAM, AIR, WATER, AMMONIA

Reg. U S. Pat. Off.

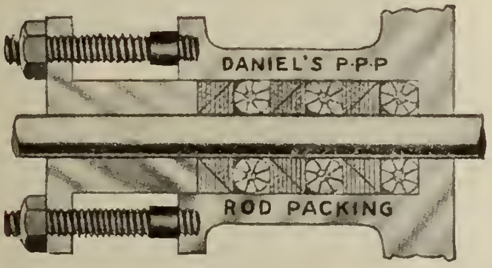


Fig: 1

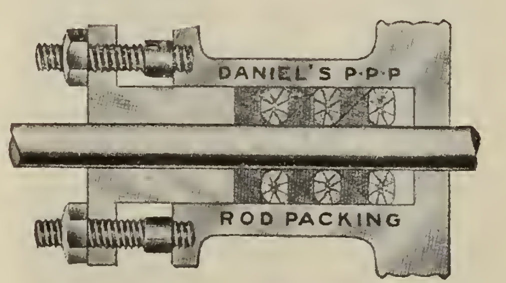


Fig. 2

Fig. 1 shows P.P.P. ("Regular" style) when first put in. Care should be taken to see that the bottom ring rests on bottom of box, and that no space is left between any of the rings.

The gland should be set up—with thumb and fingers—just to the packing. If leaking or blowing appears, it should cease when the packing becomes thoroughly warmed; if, however, it does not, set the gland up firmly for a minute or so, then set it back as far as it will go without leaking, and let it be.

Fig. 2 shows the Packing under pressure, after it has adjusted itself to the rod and box. The compression of the cushions and the slide of the wedges are clearly seen.

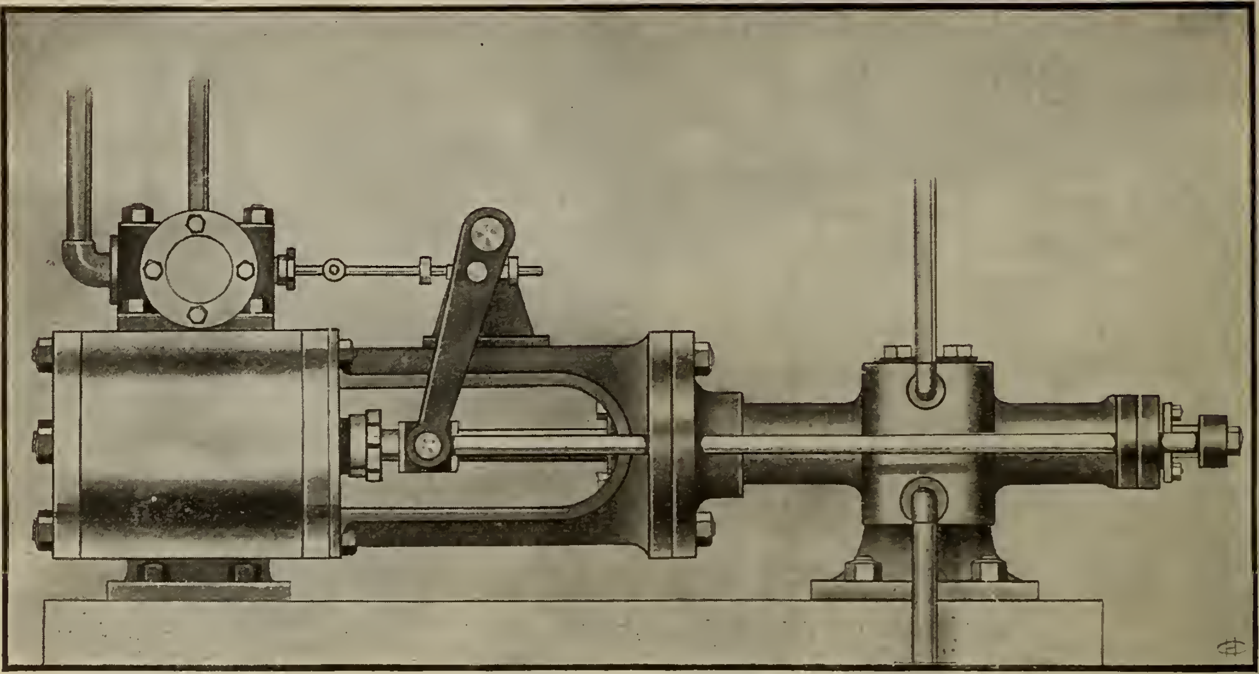
Perfect Piston Rod Packing

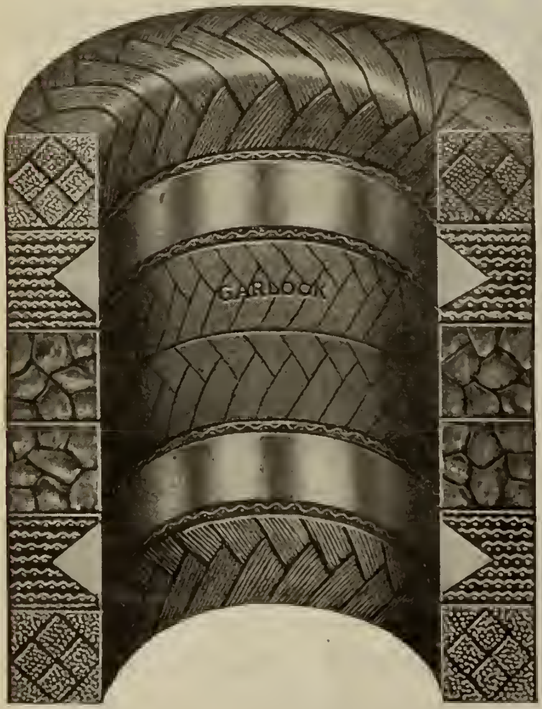
The above is the answer to the question: "What's the meaning?" (of P. P. P.) asked in our April advertisement.

Remember, DANIEL'S is the only P. P. P.—"Perfect Piston-rod Packing." Take no imitations. Get what you want or write to us.

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS
629 MARKET STREET, PHILADELPHIA, PA., U.S.A.





HYDRAULIC PACKING

Garlock Hydraulic Duo No. 960 is a combination of braided copper, metal wedge and waterproof hydraulic rings, especially designed for use on outside packed plungers of pressure pumps as used in blast furnaces, steel mills and general hydraulic work. The varying conditions of this class of work make the use of a special packing necessary as well as economical. This combination will hold a pressure of 3,000 pounds. We recommend it to all users of hydraulic packing.

This and many other Garlock Packings are described and illustrated in our new catalog, which will be mailed upon request.

The Garlock Packing Company, Hamilton, Ont.

BRANCHES:

Montreal, Quebec - - - 342 St. James St.
Toronto, Ontario - - 404 Continental Life Building.
Winnipeg, Manitoba - - - Galt Building.

SPARTAN BELTS
FOR COMPRESSORS

STRENGTH, pliability, and power to resist abnormal physical conditions are the characteristic qualities which make Spartan Belts so highly efficient for compressor work.

This high efficiency is what made possible such satisfactory service from the 10-in. Spartan Double Belt on the compressor shown herewith. The belt operates at a speed of 2350 F. P. M. from a 10-in. Motor Pulley of 900 R.P.M. under a 12-in. Lenix Idler to a 54-in. pulley on the compressor—only 6 ft. centres and transmits 75 H.P. The automatic stopping and starting device naturally subjects the belt to an intermittent load—jumping instantly from no load to full load.

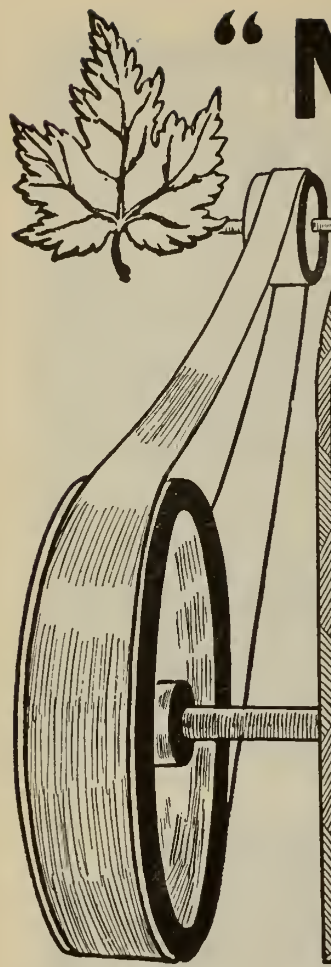
The qualities which have made Spartan Belts so successful for compressor drives make them equally efficient for all drives where conditions are unusual or quickly ruinous to ordinary belts.

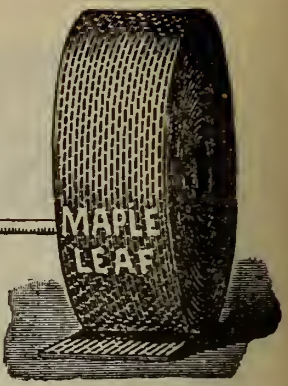
Put your hard-drive prob'ems up to Spartan Belts—the long-lived all-sufficient transmission.

THE GRATON & KNIGHT MFG. CO.
OAK LEATHER TANNERS AND BELT MAKERS
Worcester, Mass, U.S.A.
Representatives in Canada—The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria

1851 G&K
TRADE MARK

"MAPLE LEAF"





Stitched Cotton Duck
Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying. A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC
METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

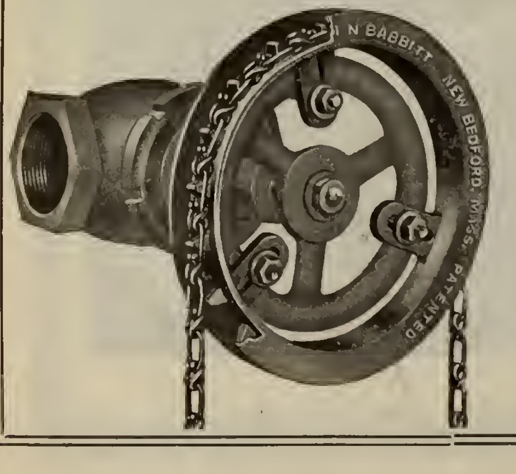
Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to $1\frac{1}{2}$ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.

MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless

Any Quantity sent
on APPROVAL



They Thought Two Would Do

in a certain big New England mill, because mill and equipment were brand new and strictly modern.

But They've Bought Just 27 of These
Babbitt Adjustable Sprocket Rims

since July 1st. Like this: July 1, two; July 20, two; July 23, six; Aug. 25, eight; Sept. 8, nine. That's the way they go, because everybody recognizes them on sight, as "Just the thing they have been looking for, but did not know where to get it." Easy to put on—goes right on your present valve wheel—easy to pay for. Ask your dealer. Send for Illustrated folder.

Babbitt Steam Specialty Co., 59 So. Water St., **New Bedford, Mass.**

A Good Looking Belt is not always a good service belt

The beauty is very often "skin deep"

Make it "Safety First"

by looking up the past and present record of a belt before placing your order.

Users of

D. K. McLaren's

Genuine British Oak-Tanned

Leather Belting

are proud of the way it serves them. It runs day in and day out with a minimum of attention, grips the pulley positively and is wonderfully strong and durable.

Right in your town there are users who will enthusiastically recommend it. Ask us to put you in touch with them and see for yourself.

Full particulars upon request.

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AMERICAN
STEEL SPLIT PULLEY

All Steel Split Belt Pulleys made by
The American Pulley Company

RECENT tests made by engineering experts of undoubted standing show that the steel pulleys made by the above company hold a belt better than cast iron or wood pulleys; have less windage, and are so efficient at all points that there is high economy in their use.

Full report of tests sent on application.

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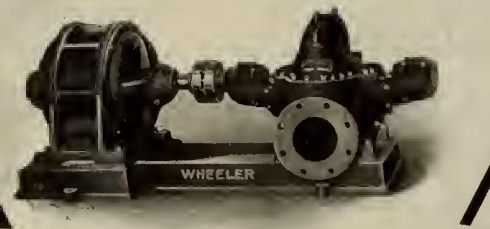
WHEELER
Motor Driven Centrifugal Pumps



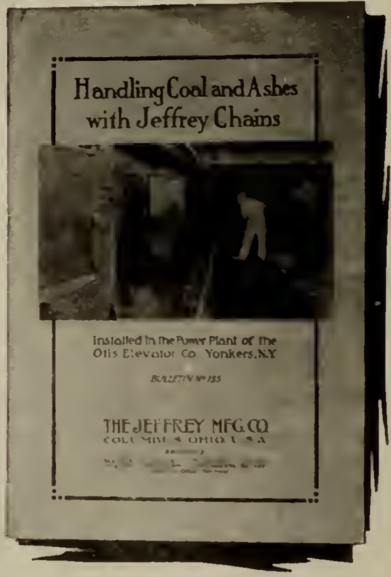
WHEELER Pumps are built for all services and all types of drives, and are designed to meet both the local conditions of the installation and the speed requirements of the driving motor.

Pumps are of the split casing type with suction and discharge nozzles in the lower half of the casing. Bearing brackets are not cast integral with the casing, but bolted thereto. Impellers are of government bronze, of the enclosed double suction type, manufactured by improved methods, which prevent distortion and result in a finished impeller which is true to pattern in all details.

Wheeler Centrifugal Pumps have been built for 20 years in capacities as high as 100,000 gallons a minute and as small as 20 gallons a minute, and for a wide range of heads.

For further information send for the new Wheeler Pump Bulletin—108-A—which fully illustrates pumps of various sizes and types, with horizontal and vertical shaft.

Wheeler Condenser & Engineering Co.
CARTERET, NEW JERSEY 135



Handling Coal and Ashes
with Jeffrey Chains

Installed in the Power Plant of The
Otis Elevator Co Yonkers, N.Y

THE JEFFREY MFG. CO

Jeffrey Chains Play a Prominent Part in Reducing Power Plant Operating Costs for This Company.

A Bucket Elevator using Jeffrey "Hercules" Chain carries coal from chute to Scraper Distributing Conveyor using Jeffrey No. 506 Steel Link Chain.

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This Bulletin has full particulars of this interesting installation. Send for copy.

The Jeffrey Manufacturing Co.
Canadian Branch and Warerooms, Montreal

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH

Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

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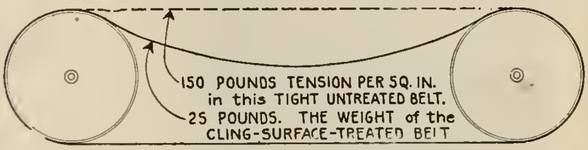
6 to 1

in favor of CLING-SURFACE


150 POUNDS TENSION PER SQ. IN. in this TIGHT UNTREATED BELT.
25 POUNDS. THE WEIGHT of the CLING-SURFACE-TREATED BELT

150÷25=6—The CLING-SURFACE FACTOR

Shaft centers here are 30 feet apart, belt is 6 inches wide and under Cling-Surface treatment, a 2-foot sag with over 80% reduction in initial tension is practical. Cling-Surface thus gives 125 pounds per sq. in. more belt capacity to be applied to *useful* work.

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Besides, Cling-Surface waterproofs the belts, stops slipping and running off, lengthens belt life, eliminates worry, increases production, and is a profitable investment in every way. It is now a semi-fluid treatment—penetrates the belt, surrounds and lubricates every fibre—doesn't have to be heated.

Why not make a trial? Want literature?

We quote f.o.b. Toronto.

Cling-Surface Co
1057 Niagara Street
Buffalo NY

I am interested in Cling-Surface and your trial order proposition.

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Firm ....

Street ....

City .... Province ....

95

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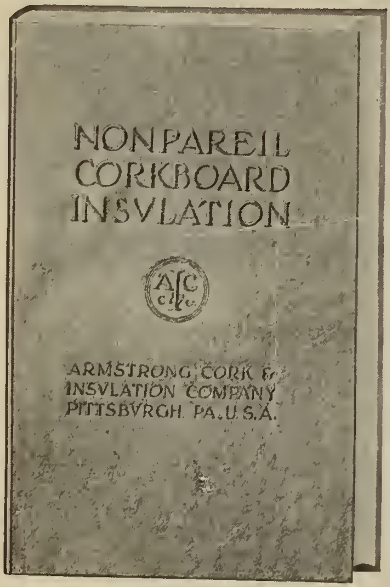
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For All Cold Storage Rooms

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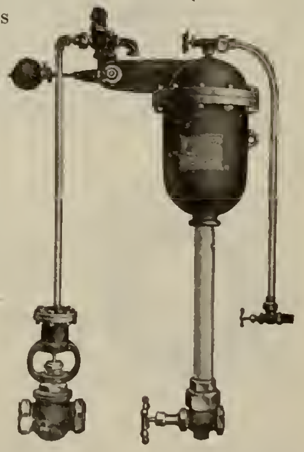

It has been on the market for 18 years, and from the time they were first offered to the trade, the Vigilant has been supplied for either continuous or intermittent service. The purchaser receives the benefit of our long experience as builders of continuous feed regulators, and when this service is desired, a controlling valve with a by-pass or continuous feed valve is furnished. This valve is adjusted by means of a hand wheel, so that water may flow into the boiler constantly and almost as rapidly as it is evaporated, thus providing a uniform feed.

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But you don't always get it, as much of it as you want, the instant you want it, and without smoke, dust, or grits.
If you don't it is because your boiler is not fitted with a "Bennis" Automatic Stoker.
"Bennis" Stokers stand for cheap steam and plenty of it, low coal bills, less labour, less wear and tear, less trouble, less worry. Why not investigate? That will cost you nothing and may save you dollars.

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Illustrated Catalogues on request.
They are sure to interest you.

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THE characteristics which are nearly general to silent chains as a class, causing their preference to belting and gearing for the transmission of power, are as follows:

(1) Positiveness, without the noise of gearing.
(2) Flexibility, without the slip and lost power of belting.
(3) Convenience for installing, either short or long centers being permissible.
(4) Elasticity, in addition to the positive action.
(5) Quietness, at either high or low speed.
(6) Not affected by heat, cold or dampness.
(7) Run slack, less journal friction is caused than with belting.
(8) Smoother action and less wear than gearing, as large number of teeth are always in working contact.
(9) Economy and flexibility in use of floor space, as center distances can be arranged to suit.
(10) 98 to 99% sustained efficiency, a saving of from 3 to 10% of your power compared to the efficiency of other systems even when they are new.

Where a system so obviously superior to others CAN be used, the next and very natural question is—"What *make* of chain?"

There are several different *makes* of silent chains, but practically only *two types*, one, the MORSE "Rocker-Joint" Type, and the other, the single round pin type of construction utilized by all other makers.

The MORSE "Rocker-Joint" is an exclusive patented feature of MORSE Silent Chains. It has been used in MORSE Silent Power Chains since 1900. If there ever was a period of probation for this totally different construction, it has passed long since.

Today, almost 1,500,000 h.p. of MORSE Silent "Rocker-Joint" Chains prove in daily use not only their superiority to belting and gearing, but also a marked superiority to other makes of chains.

We know that the first (5,000 h.p.), second (1,500 h.p.), third (1,200 h.p.) and fourth (1,000 h.p.) largest chain drives in the world are of the MORSE "Rocker-Joint" Type, and we believe the first **ten** largest drives do not include any other **make** of chain.

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You will find the same decided preference for, and confidence in, MORSE "Rocker-Joint" Chains for the smaller powers from ¼ h.p. upwards, a true indication of merit in every service—a lead it will pay you to follow.

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Morse Chain Co.

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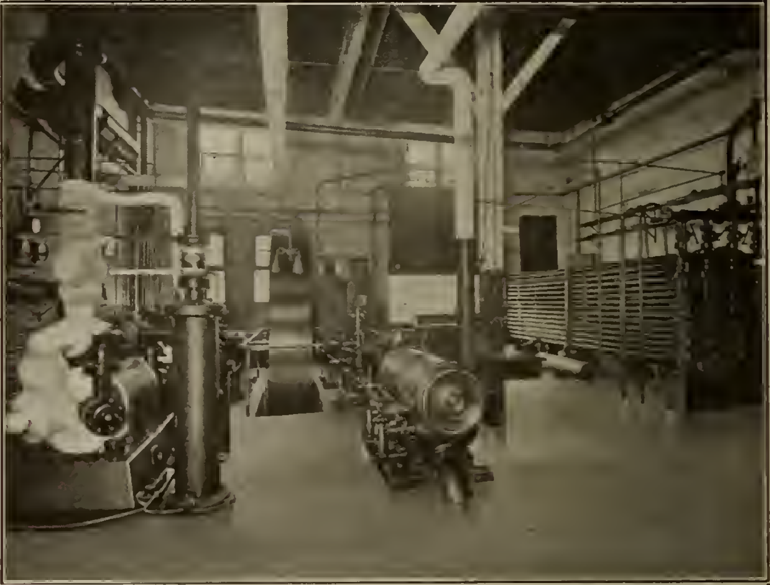
Please send a copy of your Publication No. 14 to the address given below. Also name preliminary proposition for a MORSE Silent Chain Drive as per the following specifications:

Maximum hp. to be transmitted ....
Drive from ....to ....
R.P.M. of driver ....Of driven ....
Distance between shaft centers ....inches
Daily use desired of about ....hours
Name of individual ....
Company ....
Address ....

S-9, POWER HOUSE, May, 1916

REFRIGERATION DEPARTMENT



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Modern Design
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Efficiency in Operation
A Proportionate Price

Linde Plants reduce the cost of production by maintaining uniform conditions and eliminating waste.

A PROVEN SYSTEM FOR EVERY NEED. ASK OUR ENGINEERS.

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MONTREAL TORONTO WINNIPEG CALGARY EDMONTON VANCOUVER
Makers of Quality Machinery in Canada since 1896.

Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones. AMMONIA FITTINGS. CONDENSERS. BRINE COOLERS. ETC.

Corliss Engines Special Machinery

THE VILTER MANUFACTURING COMPANY
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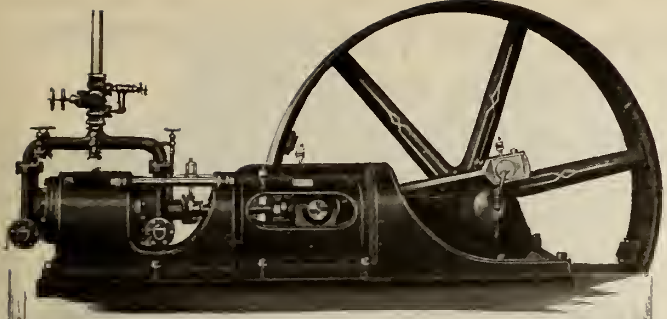

When you are in the market for a high-class ice-making or refrigerating plant, do not overlook the service and equipment which we have to offer. It is worth your careful investigation. *Your inquiry will be appreciated.*

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High Operating Economy combined with **Great Durability** are secured in

"Kerr Economy" Steam Turbines

by **Conservative Design. Moderate steam velocities** are employed—together with **Moderate bucket speeds.**

There are **wide clearances** between rotating and stationary parts. The steam economy after many years' constant use is practically the same as when the machine is new. If you want a Turbine embodying **lasting economy** and **moderate wear and tear**, specify **"Kerr Economy."** This is borne out by nearly 2,000 "Kerr Economy" Turbines in actual daily use in all parts of the world.

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Our facilities are complete in every detail. Our Organization is such that we can successfully execute any order for Refrigerating or Ice-Making Machinery, no matter how large or how small.

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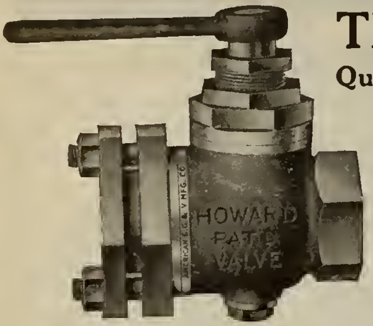

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Quick, Full Opening, Absolutely Tight, and will Remain So

Put one of these Valves in service where you never could yet get a valve Valve to stand up and WATCH RESULTS.

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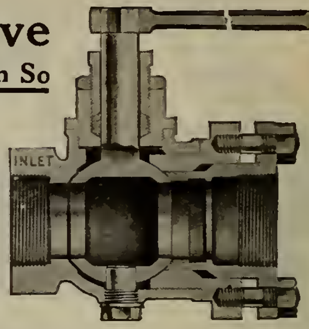

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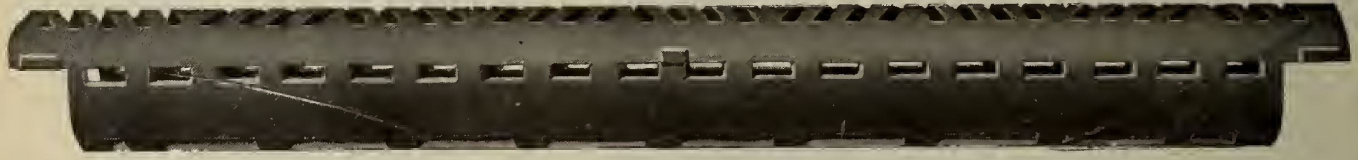

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FOR ALL PROBLEMS—**Steam—Grate Bar—Furnace—write THOMAS**

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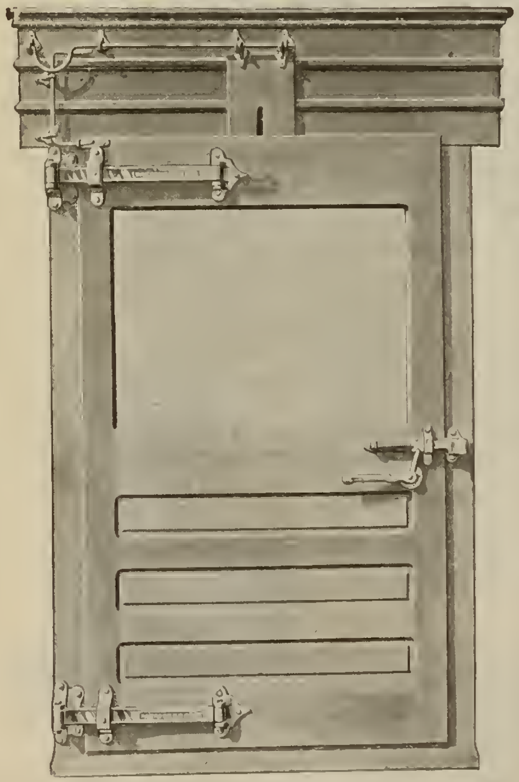

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Cold Storage and Freezer Doors either Standard or Fireproof **DOOR**

The "Jones" Door, with double seals of contact between the Door and Frame, is the heaviest constructed, most durable and best insulated Door made. Proof—Compare catalogued weights and detail sectional views, or ask P. Burns & Co., Gordon, Ironsides & Fares Co., Canadian Fish & C. S. Co., Prince Rupert; Frontenac Brewing Co., Montreal, Quebec, Canada; Canadian Government Agricultural Dept., or any other large users of Doors of National or International importance. Most of them say "the Door that gives us the least trouble is the 'Jones.'" Built for strength and durability.

We have a new 96-page illustrated catalogued treatise on Insulated Doors. The most complete ever issued, free for the asking. It describes, in addition to the above:

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The "Jones" Vertical Sliding Door.

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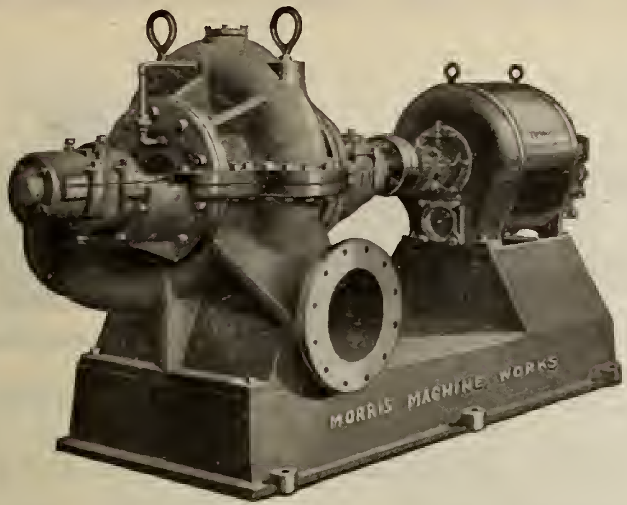

Accessible Pumps

The "Morris" Horizontally Split Shell Centrifugal Pump is very popular with pump users — can be inspected quickly without breaking pipe connections.

THE LATEST UP-TO-DATE DESIGN BACKED BY HALF A CENTURY'S PUMP EXPERIENCE

The cut shows a steam turbine driven pump, the same design being used for motor and other drives. We build centrifugal pumps for all services, including BOILER FEEDING, TANK PUMPING, GENERAL WATER SUPPLY, BRINE WORK, ETC. Send us your inquiries for pumps of all types.

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Canadian Sales Agents for

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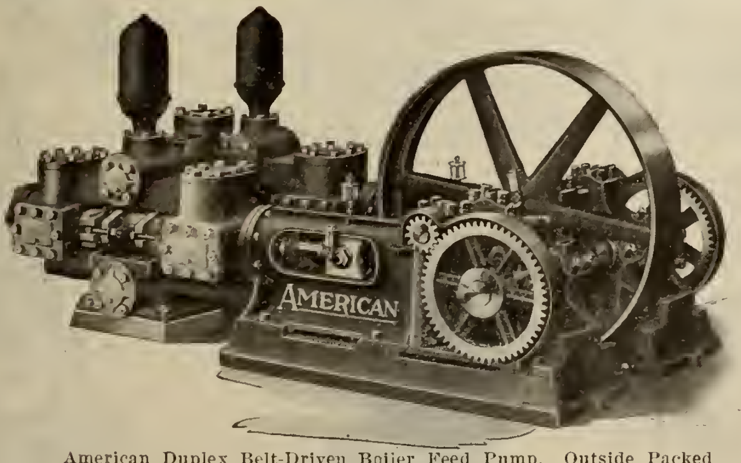
MARSH and AMERICAN

Pumping Machinery. Steam and Power Driven

The world has used and endorsed over 130,000 Marsh and American Pumps. Twenty-seven years of pump manufacture have proved our ability and perfected our facilities. Marsh and American Pumps are 100 per cent. correct—from the selection of raw material and accuracy of design to the actual pumping service, day in and day out, year after year. They ask no apologies and never have to explain away any error in service or failure in efficiency.

Investigate. Ask for our 250-page catalog illustrating and describing the line. Your pumping problems will be answered fully and satisfactorily through this investigation. This catalog will be sent by return mail in answer to your inquiry. Your copy is awaiting your prompt request.



American Duplex Belt-Driven Boiler Feed Pump. Outside Packed Plunger Pattern.

AMERICAN STEAM PUMP COMPANY

BATTLE CREEK, MICH.

CANADIAN AGENTS:

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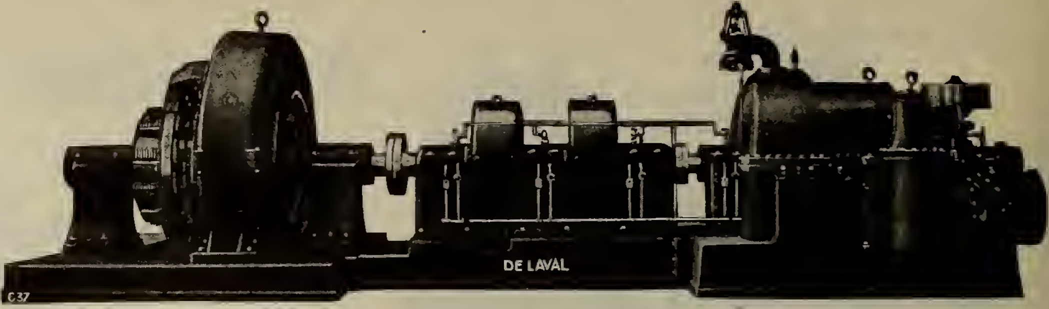
De Laval 1,200 kw. Multistage Turbine Driving Standard-speed Direct-current Generator through De Laval Speed-reducing Gear; utilizing low-pressure steam and supplementing with high-pressure steam as required to carry the load.



The DeLaval Double Helical Gear is the Pioneer Gear of this Type by Over Twenty-Five Years

Since the first De Laval gear reduction was built, the De Laval Steam Turbine Company has produced some 6,500 gear reductions and has introduced numerous improvements in design, materials and methods of manufacture. The building of high-speed turbine gears requires an expensive equipment of special machinery and must be performed carefully and accurately by highly trained men. Only in this way can absolutely correct tool contours, spacing, angles and alignment—which are essential to smooth and noiseless running—be obtained. Gears which are correctly cut in the first place, rigidly supported in the correct position, and properly lubricated, will run indefinitely without trouble or wear, while gears that are not correctly cut will not run satisfactorily, no matter how supported.

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Write for book—D-61—"Use of Steam Turbine to Increase Plant Economy."

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BAWDEN NEVER SHORT STROKE PUMPS

Keep Your Water Lines Clean

Write for Catalogue and Prices.

Pumps For All Purposes.

A Bawden Basket Strainer should be on every pump suction. It will catch all the dirt and is easily cleaned by emptying the basket.

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Limited
HAMILTON, ONT.

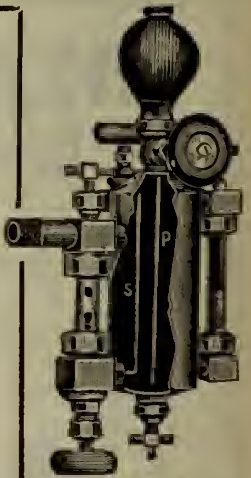
Manufacturers of

LUBRICATORS, OIL CUPS and INJECTORS

Steam Engine and Boiler Appliances

Our products are not only universally satisfactory—they possess merits that have established a big re-order business and which have more than doubled our production over what it was a few years ago.

See our line—write for illustrated catalogue.



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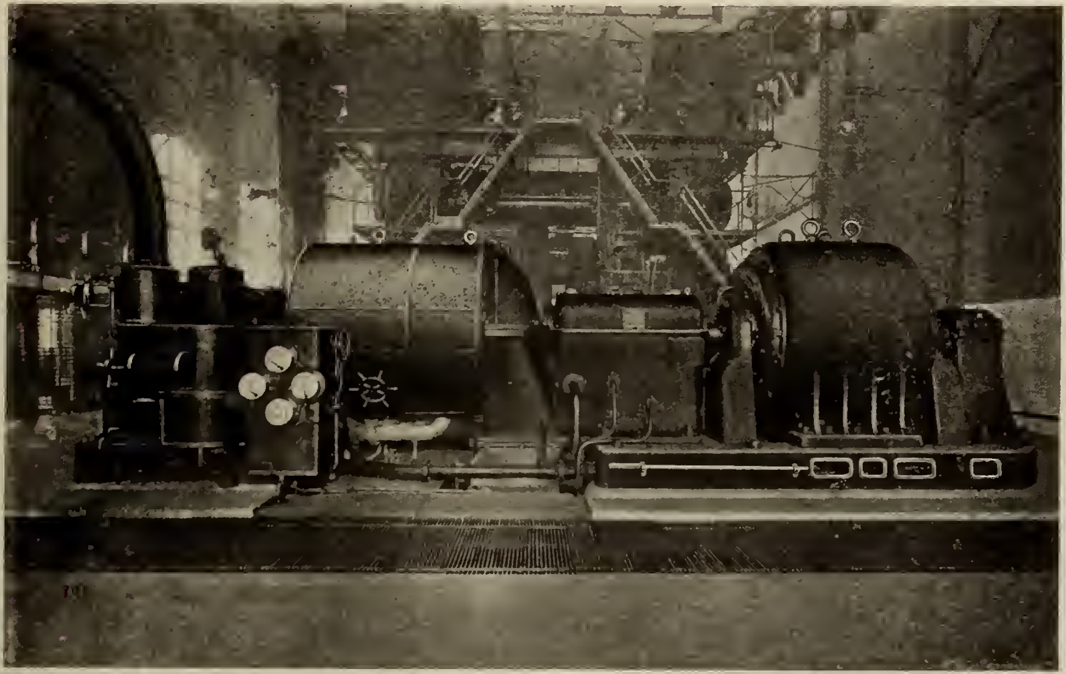
Engines and Air Compressors



MONTREAL TRAMWAYS, HOCHELAGA PLANT
2,500 Kilowatt Belliss & Morcom Steam Turbine

We have for immediate delivery several Belliss & Morcom Engine Generator Sets. Write for particulars.

Send Us Your Enquiries For

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Steam Engines, Boiler Feed Pumps, Condensing Plants, Producer Gas Engines, Air Compressors, Oil Engines, Steam Turbines, V-notch Water Meters.

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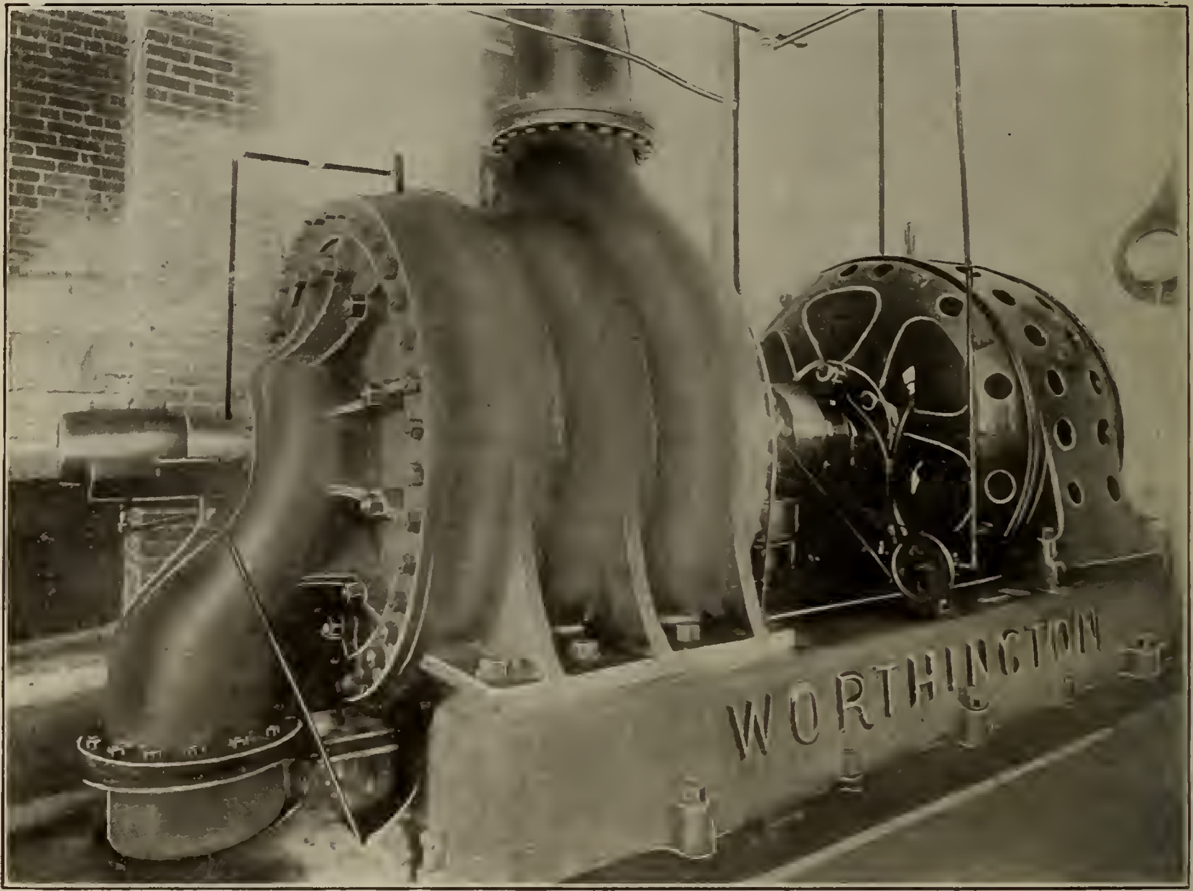
Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps—centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment
of their Boiler, Feed and General Service Pumps

The Publisher's Page

By B.G.N.

WE reproduce below copies of letters received recently from two of our subscribers. The one from Mr. Davis, in charge of the power plant of St. Michael's Hospital, Toronto. The other from Mr. Bergh, engineer in charge of the Chisholm Milling Company's flour plant, also in Toronto.

One is in charge of the power equipment in a public institution, the other responsible for the efficient operation of the power plant in a manufacturing establishment.

Toronto, April 4th, 1916.

Gentlemen:

I bought the first copy of Power House for an article describing a certain fuel economizer in the October, 1908, issue. Its contents were so interesting that for some months I continued to buy the successive numbers until April, 1909, when I handed you my dollar for a year's subscription.

Since then every copy has contained practical help, either in the descriptive articles, experiences of other engineers, in the Operator's Course, and last, but by no means least, the advertisements through which I have made many satisfactory purchases after corresponding with various firms—always receiving most courteous replies and full information.

I have added many names to your regular readers and wish you all success.

Yours sincerely,
HENRY BERGH.

Toronto, Ont., April 15th.

Publishers of The Power House,
Toronto, Canada.

Gentlemen:—

I would like to take advantage of this opportunity to say a few words concerning my good friend, The Power House Magazine. I find it a very helpful paper and I think every engineer should have it on his desk.

Coming in as it does every month it will enable them to keep in touch with the different methods that are being used in other plants.

I always look forward to receiving The Power House, as there is always something new and interesting. The different courses which are published each month are very vaulable. Take the Operator's Point of View and the Operator's Instruction Course, for instance. These, together with the Questions and Answers series, are alone well worth the subscription price. In fact, one instalment of these different courses is worth all it costs for The Power House for one year.

Then if you are not just sure on any particular point all you have to do is put the question in The Power House and you may rest assured that it will be answered correctly. This alone is worth a great deal to anyone working at the engineering profession.

I certainly think that any engineer wishing to better himself in his profession and keep in touch with up-to-date methods of plant operation should regularly read The Power House Magazine.

Wishing you every success, I am,

Yours sincerely,
A. E. DAVIS.
Chief Engineer,
St. Michael's Hospital.

You can see that both these engineers are enthusiastic readers of the Power House. Both have been benefited by a careful study of the editorial and advertising pages. And it is on the subject of advertising that I would like to say a few words to our friends, the engineers.

I wonder how many of you ever stop to consider just how brimful of information the advertising section is each month?

I wonder how many realize that each advertisement is a personal message to you from firms of the highest standing?

I wonder how many have written to our advertisers asking for catalogues and full information, as did Mr. Bergh, not necessarily with the view of purchasing immediately, but in order to have complete data on hand, in case of equipment being required in a hurry some time?

You see advertising is the modern and progressive manufacturer's way of telling you about his line. Advertising, you know, has helped to a wonderful extent in raising Great Britain's immense army. It has been instrumental in quickly raising millions of dollars for patriotic purposes. It is assisting in marketing the chief products of the world to-day.

The advertising in the Power House is intended for you and published for you just as much as the editorial pages. You will secure many valuable pointers by closely following the advertising sections; you will see the latest and most up-to-date power equipment illustrated and described; you will find that manufacturers offer you their catalogs (valuable textbooks in themselves). Write to our advertisers and ask for their literature. Familiarize yourself with the different types of engines, boilers, stokers, grate bars, injectors, valves, pumps, etc. A close study of same will prove immensely valuable. Try it. Many of you have, I am sure, but why not all of you?

Power Equipment

Steam Engines and Turbines, Return Tubular and Water Tube Boilers, Heaters, Pumps and Condensers

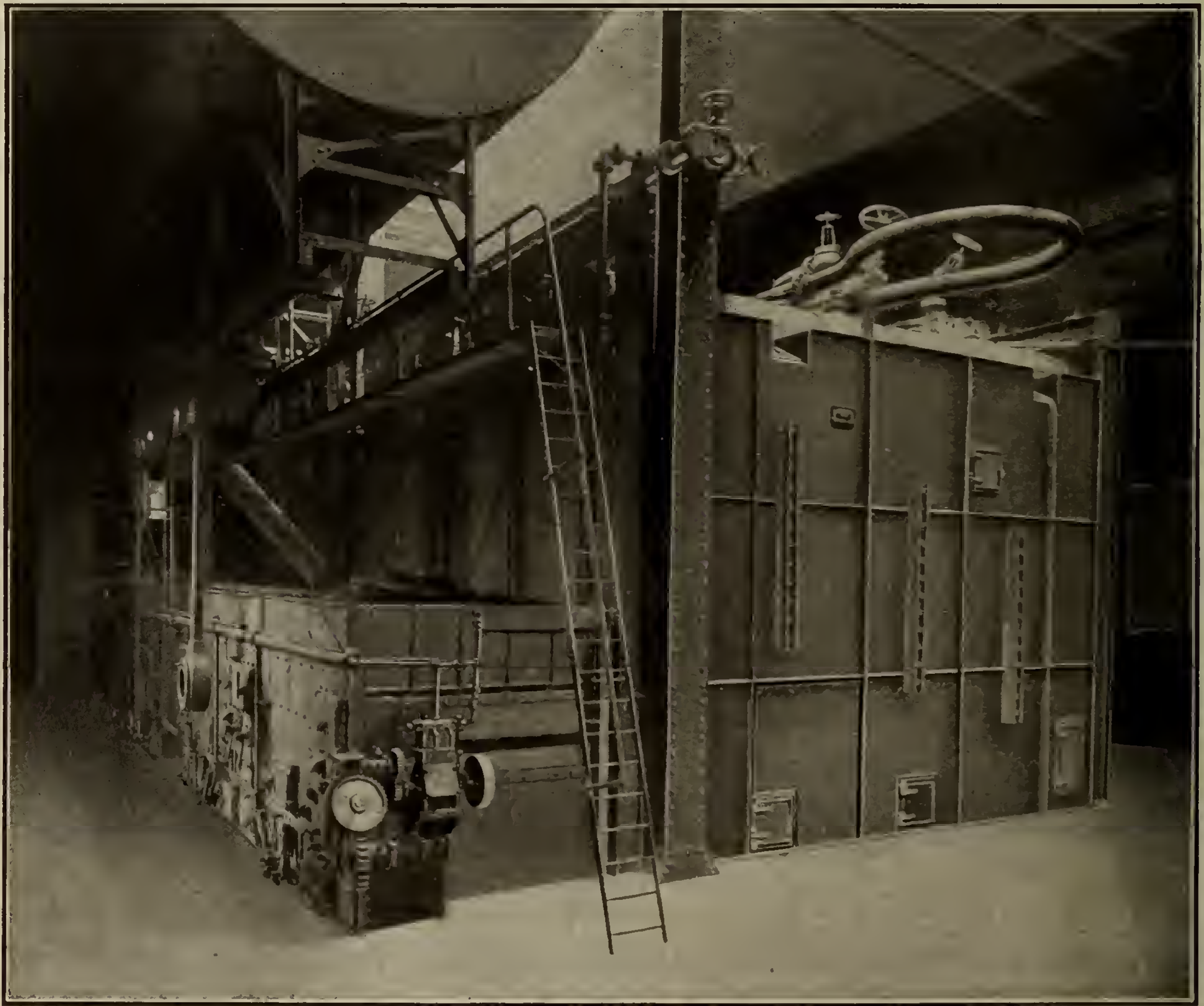


Illustration shows the Boiler Room at the New Asylum for the Insane, Whitby, Ont. equipped with 4 G. & McC. Co. Sectional Water Tube Boilers.

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Artificial Ice Plant of the Lake Simcoe Ice Supply Co.

Staff Article

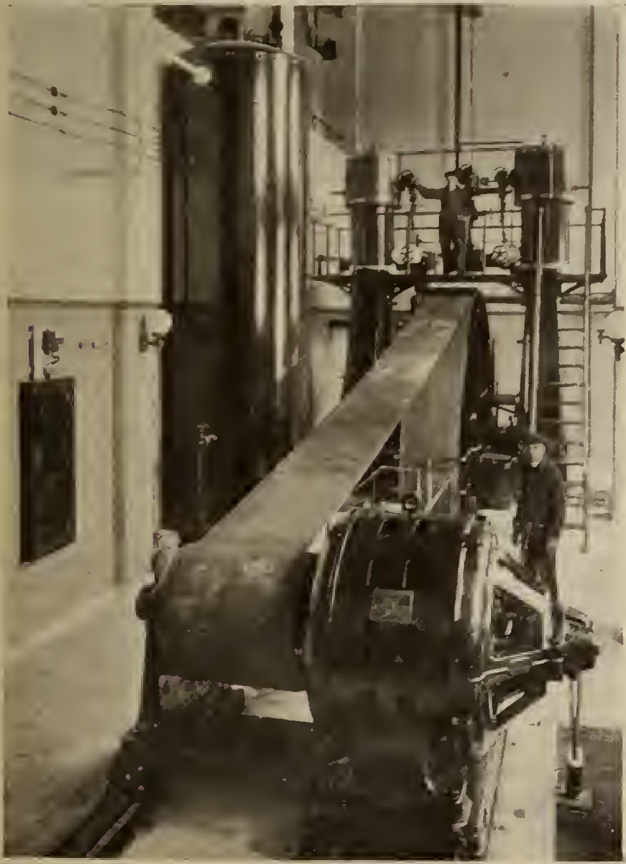
The steady improvement which has taken place in the manufacture of artificial ice and the increasing demand for this product has resulted in the establishment of plants even where natural ice is abundant and readily obtainable. The plant of the Lake Simcoe Ice Supply Co. at Toronto is not only up-to-date, but the first of its kind established in that city.

An interesting development in the ice business in Toronto is the new artificial ice plant which has been built by the Lake Simcoe Ice Supply Co., on their property on Dupont St. This plant is not intended to take the place of their regular supply of natural ice, but will serve as a valuable auxiliary and enable the company to meet any demand that may be made upon its stocks of ice during the summer months. In the harvesting of natural ice several factors have to be taken into consideration which involve losses of one kind or another. The most important of these are handling, breakage, meltage and storage. In the artificial ice plant, breakage and meltage are eliminated, while handling charges and the storage capacity required are considerably reduced. For these reasons it is anticipated that the cost of the artificial ice at the point when it is ready for delivery to the consumer, will not be higher than the natural product, while further, the artificial ice is perfectly clean and pure and more readily marketable. The product of the new plant will be sold under the trade name of "Hygeia."

Forty Years in Existence

The original name of this concern was the Spring Water Ice Co., which was formed about 40 years ago for harvesting natural ice from spring water on some lots on Avenue Road. At a later date the name was changed to the Lake Simcoe Ice Co., and the plant moved out to Lake Simcoe. Here the natural ice is harvested and a large quantity stored, the balance being shipped to Toronto, where the company has six store houses. The Dupont St. branch is the largest and best located as a distributing point, being the centre of a large and well populated district. The Dupont St. property represents a total investment of about $180,000 of which amount $90,000 covers the building and equipment of the new artificial ice plant. The C.P.R. tracks run alongside the property and are utilized for bringing in the natural ice and also in connection with the company's coal business.

The plant under review was put in operation in April. The construction of the building was started last fall and the machinery and equipment installed during the winter. The plant has a capacity of 75 tons of ice per 24 hours and is of the very latest design embodying all the features known at the present time for producing ice of the best quality and most efficiently. The entire plant was designed, furnished and installed by the Canadian Ice Machine Co., of Toronto. F. S. Mallory also of Toronto was architect of the building which was designed in accordance with sketches submitted by the Canadian Ice Machine Co., who acted as engineers for the building, as well as for the machinery and equipment. Power for the plant is supplied by the Toronto Electric Light Co. The current is alternating 3 phase, 25 cycle and is transformed down to 550 volts for the motors.



"YORK" ICE MACHINE SHOWING MOTOR AND BELT DRIVE.

75-TON "YORK" ICE MACHINE SHOWING SIDE NEXT TO MOTOR.

Freezing Tanks and Equipment

The process is similar in a general way to that usually adopted for making artificial ice. There are however a number of important features to be noted which make the plant of special interest and combine to make it highly efficient. This ice is frozen in galvanized iron moulds surrounded by brine. Each mould is 11½ in. x 22½ in. x 60 in. deep and will make a cake of ice weighing 400 lbs., exclusive of the waste ice that forms above the grid, which is discarded. The water for filling the cans is filtered and precooled first by passing through coils of galvanized pipe covered with the waste ice from thawing, and later in a water storage tank where it is cooled down to about 38 or 40 degrees before passing into the cans through automatic can fillers.

The brine tanks in which the cans of water are placed while freezing are two in number, each of 40 ft. x 27 ft. 6 in. x 5 ft. 3in. deep, and located side by side on the second floor of the building, directly over the ice storage room. The tanks are filled with salt brine and are equipped with 1¼ in. direct expansion cooling coils arranged for the ''York'' flooded system and their latest type vertical accumulator. The tanks are insulated with best grade ''Nonpareil'' moulded cork 4 in. thick under the bottom, with granulated cork around the sides, oak top, framework and covers. The tanks are arranged to contain 748 of the above mentioned ice freezing moulds, which allows forty-eight hours to freeze each cake and still be able to pull out the capacity of seventy-five tons per day. The cans are lifted from the tank by means of ''Sheppard'' electric hoists which lift two cans at a time.

The ice is thawed out from the cans, first by tempering or allowing them to stand on the dumping platform exposed to the air, then by dipping into tanks containing warm water. They are then placed in the can dumps, which tilt the cans, allowing the cakes of ice to run by gravity to the automatic pneumatic lowering devices, which drop two cakes of ice at a time to the storage room below. This equipment was supplied by the Mechanical Handlor Co., Hudson, N.Y.

Procuring Transparent Ice

Although only the purest filtered water is used in the plant, ''York'' pressure sand and charcoal filters being used, the ice can only be made transparent by keeping air blowing in the cans, and thus keeping the water in motion during the freezing process. This is accomplished by means of a small brass tube which passes down the side of the can and allows the air to blow in near the bottom. While the ice is freezing, this brass tube is connected to the air pipe in framework of floor by a rubber tube, which is disconnected when the ice is ready to be lifted out. A galvanized iron perforated plate called a grid is suspended about the level of the water in the cans, and as the ice freezes, it expands and the water rises above the grid a few inches, in which collects any sediment in the water thrown out in the freezing process. This portion of the ice cake above the grid is thrown away after thawing and the grid makes a perfectly square top to the cake and makes all cakes of a uniform height.

The air for this purpose is first taken through a hood from the outside atmosphere and passed through a ''Gardner'' 10 in. x 12 in. horizontal, double acting, air compressor, equipped with unloader device for maintaining forty pounds pressure. The compressor is driven by a 20 h.p. Canadian Westinghouse motor and discharges into an air receiver 5 ft. diameter by 18 ft. high. After leaving the receiver the moisture is removed from the compressed air, first by passing it through a double pipe cooler made of 2 in. and 3in. pipe, then through a shell and coil brine cooler in which brine is circulated by means of a small centrifugal pump from the freezing tank. The cold dry air thus obtained then passes through a reducing valve which holds a constant pressure of about twenty-five pounds on the laterals and connections which distribute the air to the cans. This air system, which is of the highest importance for obtaining clear ice is equipped with, in addition to the unloader on the compressor and the automatic reducing valve, electrical alarm gauges which give the operator ample warning in case any of the automatic devices fail to work.

FREEZING TANKS SHOWING CAN HOIST AND CAN-FILLING APPARATUS.

Refrigerating Machinery

The main unit of plant is the 18 in. x 28 in. ''York'' vertical, single acting, belt driven, ammonia compressor, driven by a 200 h.p. Canadian Westinghouse, slip ring motor with controller for varying the speed from 300 to 550 r.p.m. The belt was made by Beardmore & Co., and is of leather, 2-ply 28 in. wide. There is also an auxiliary outfit for use in pumping out, holding the temperature of the ice storage room and tanks, when the large machine is shut down. This consisting of a 6½ in. x 6½ in. ''York'' single acting, enclosed type machine, driven by a 15 h.p. Canadian Westinghouse motor. All the motors are 3 phase 550 volt machines.

Ice Storage Room

The ice storage located directly under the freezing tanks is a room 63 ft. x 57 ft. x 10 ft., and is cooled by 2 in. direct expansion coils located on the ceiling. This room is insulated with 4 in. ''Nonpareil'' sheet cork applied in two layers with cement finish; columns also are insulated and protected with sheet iron outside the cork. Two ''Hillock'' cold storage doors open from this room, out to the loading platform and the other to the engine room, while the ice is passed out from the storage room to the platform through ''Jones'' ice chutes, which automatically count the cakes.

Condensing Plant

The ammonia condenser is located on the roof directly above the engine room on a super-structure supported by the main building columns. It consists of eight coils of the very latest type ''Shipley'' atmospheric condensers, made of 2 in. galvanized pipe; each coil is 12 pipes high x 20 feet long. They are installed in a water tight pan made of ¼ in. sheets, about 6 in. deep.

The condensing water supply is taken from the city main, but, in order to cut down the cost, at 60 ft. x 11 ft. 6 in. ''Spray'' cooling tower is used, so that the same water can be used over again after it has been cooled by the atmosphere. This cooling tower is located directly above the condenser and the cooled water passes by gravity from the tower pan over the condenser into the condenser pan, thence to the circulating pump located in the engine room, and back up to the tower. The water circulating pump is of the Smart-Turner centrifugal type, direct connected to a 10 h.p. Canadian Westinghouse Motor. The make-up water for the cooling tower to take the place of what is lost by evaporation and what is used over the can dumps is secured from the supply which has to pass through the water dehydrator for cooling the air.

The entire plant occupies a space 61 ft. x 100 ft. the engine room taking up a space 32 ft. x 61 ft. at the front of the building running up the two full stories. The ice storage room on the first floor takes up the balance of the floor space and the ice tanks and dumping platform located directly above, take up the same space as the ice storage room.

Some of the features of the plant are its extreme simplicity and the very few pipes in sight; the flooded system does away with much of the attention formerly required in operating the expansion valves in the freezing tank, and the electric drive for all units and auxiliaries requires the least possible attention. The air circulating system for producing clear ice is practically automatic, as compared with the attention other type plants for securing clear ice require.

The officers of the Lake Simcoe Ice Supply Co., are James Fairhead, president and manager; H. J. Fairhead, vice-president and asst. manager; T. G. Rogers, sec.-treasurer and E. Bedford, superintendent.

* * *

CONCERNING HIGH SPEED MACHINERY

ON March 25 J. A. McLay read a paper entitled "Hints on Installing, Erecting and Starting-up of High-speed Machinery" before the Association of Mining Electrical Engineers at Wakefield. The author said he had found that many troubles which had developed in connection with high-speed machinery were due to defective erection on site or starting-up. He considered it advisable always to submit the plans for erection to the manufacturers of the plant.

The four points which settled practically the satisfactory working of any high-speed machine were: (1) foundations and grouting up; (2) level and alignment; (3) coupling; and (4) connections. They were all of equal importance. Standard high-speed machines, such as turbine pumps, fans, motors, etc., were designed to be mounted on solid foundations of concrete, brickwork, masonry or steel construction, and they should not be set up on temporary foundations, such as timber, without first consulting the makers.

HIGH PRESSURE STEAM PIPING

AT the recent annual meeting of the American Society of Mechanical Engineers in New York, considerable interest centred round the methods of installing high-pressure steam-piping systems of large central stations. During the discussion reference was made to the practice of fusing together the lap flanges of pipes to avoid the blowing out of gaskets and steam leakage.

It was pointed out that one large concern, the Commonwealth Edison Co., of Chicago, is now doing this at its Fisk street station. Fused flanges are being used between the steam header and the turbine. Instead of using the customary copper-asbestos gaskets inserted between the flanges, the flanges are drawn up face to face and bolted rigidly together. The edges are then welded together. The thickness of this weld is quite small, since the intention is not to increase the mechanical strength of the joint, but to enable the elimination of gaskets, and in this way prevent the leakage of steam. The welding of flanges in this manner has proved satisfactory, since there are no gaskets and there is entire absence of leakage.

* * *

HIGHER STEAM PRESSURES

SINCE the laws of thermodynamics have been recognized by engineers as a sure guide to improvement of heat engine economy, there has existed a tendency to increase the temperature range of the working fluid; that is, to increase the temperature at which the working medium absorbs heat and lower the temperature at which it rejects heat. This has led, in steam engine practice, to the recognition of well-defined limits imposed by operating conditions; namely, a maximum temperature of 600 degs. F. and a minimum of 80 degs. F., corresponding to a pressure of one-half pound per square inch, or 29 inches of vacuum.

In the best present-day practice, the maximum steam pressure is 200 pounds per square inch, absolute, with a superheat of 200 degs. F. The corresponding temperature of evaporation is 382 degs. F., and the bulk of the heat is absorbed at a temperature 200 degs. F. below the maximum. It seems reasonable to expect that the approximation to the ideal Carnot cycle, and simultaneously the economy, would be improved by using higher pressure and less superheat; that is, by increasing the temperature at which the bulk of the heat is absorbed without increasing the maximum temperature. Steam pressures might be increased to 600 pounds per square inch without using temperatures higher than those employed in modern practice, and the difficulties encountered by the designer would not be formidable and would be more easily met than those of some types of explosion engines which have been successfully designed.—A.S.M.E.

* * *

DISCHARGE PIPES FROM SAFETY VALVES

ONE of our inspectors, says The Travellers' Standard, while examining a boiler recently, discovered a dangerous condition which illustrated the lack of foresight sometimes displayed when installing discharge pipes from safety valves. He found that a whistle had been attached to the end of the discharge pipe from the safety valve since his last visit to the plant, and that a stop valve had been placed between the safety valve and the whistle. It is easy to see that if the stop valve were closed the safety valve would fail to operate in case of overpressure, and a serious accident might occur. In other words, the safety of the working force of the entire plant was made to depend solely upon the faithfulness and intelligence of the boiler attendant.

Installation Pointers

We have repeatedly warned against placing valves of any kind in the discharge pipes from safety valves, and have recommended that the pipes be as short and direct as possible, with no sharp turns or bends, and that they should never be smaller in area than the area of the safety valves to which they are connected. When possible, the discharge pipes should be extended nearly horizontally, to some point in the boiler room where the escaping steam will not be objectionable. This arrangement makes it certain that the fireman will hear the steam escaping, and that his attention will be called to the fact that one or more of the safety valves are blowing off—a condition which might not be immediately noted if the pipes discharged into the outside air.

The pipes should be installed on a slightly descending grade away from the safety valves, so that the water of condensation will be automatically drained from the pipes and the upper parts of the valves. If for any reason the pipes must be extended vertically, open drains of ample size should be located at the lowest points in the pipes. Special care should be taken during the winter season to prevent the condensed water from freezing in discharge pipes that are exposed to the outside air.

The pipes should never discharge into passageways either inside or outside of the building (even if such passageways are seldom used), nor into workplaces, nor at other points where persons are likely to be endangered by the escaping steam.

Nominal, Indicated, Brake and Shaft Horse Power Ratings

By James Watt

The accompanying article constitutes the substance of an essay which received a prize award from the Institute of Marine Engineers. The author, a graduate of the Institute, discusses in easily intelligible language the various systems and methods that have been and are employed in determining the horse-power of various prime movers, and, as a consequence, we believe a large section of our readers will find perusal of the article peculiarly helpful.

A PIECE of mechanism or a machine must in the first place be designed by the scientist—then the economist steps in and asks for a means of predicting or obtaining the output of the machine in order to compare the merits of the various designs. In the case of prime movers, several means have been adapted, according to the various conditions, to obtain the various outputs and efficiencies; the following are principal bases upon which such may be compared.

Nominal Horse-Power

New times demand new measures and new men, and so nominal horse-power, which in Watt's time conveyed some idea of the size and capacity of any engine, has now litlte more than historic interest. Prior to the introduction of the steam engine, the only power other than water was animal power. It was quite natural that when steam was introduced, the power of the new prime mover should be compared with that which it superseded. It was estimated that an average dray horse could do work at a rate of 33,000 ft. lbs. per minute, so Watt fixed this as a standard or unit which he called a horse-power. He wished also to be able to predict the power which a new engine would develop, so, as a result, he more or less standardized the chief features in the design, and so formed from observation the following more or less empirical rule:—

$$\text{Estimated or n.h.p.} = \frac{A\times 7\times 128\times \sqrt[3]{\text{stroke}}}{33{,}000}$$

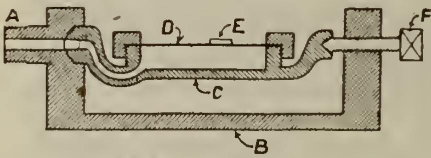
Where A=area of piston in square inches.

7=mean effective pressure. (This was obtained by observation).

$128\sqrt[3]{\text{stroke}}$=piston speed. (The engine was so designed to give this speed).

From this expression it is seen that the numerator gives the number of foot-lbs. of work done by the engine per minute, and by dividing by 33,000, the number of units of power or horse-power is obtained. This figure Watt called the nominal horse-power of the engine, and is really what is now known as the indicated horse-power. In this expression there are only two variables, the area and the stroke; the mean effective pressure and the piston speed are constants. Obviously, in due course, when higher pressures and increased piston speeds were used, great discrepancies took place, with the result that under modern conditions the n.h.p. according to the formulae is of no practical value. At the present day the term n.h.p. has almost fallen into disuse, except in a few cases where the expression has been more or less modernized, and often when these various rules are applied to the same engine, the results vary between wide limits.

Indicated Horse-Power



DIAPHRAGM INDICATOR

A—Connection to engine cylinder. B—Main frame. C—Rocking case. D—Thin steel diaphragm. E—Small mirror. F—Adjusting pivot.

At the present day we still maintain the original idea of Watt regarding the capacity of an engine, but have altered it to suit the varying conditions, etc. In considering the actual horse-power developed in an engine cylinder, the following functions must be taken into account:—Mean effective pressure, i.e., the average pressure on the piston throughout the stroke; the length of the stroke; the area of the cylinder; the number of working strokes per minute. By multiplying these functions together the total number of foot-lbs. of work done per minute is obtained, and thus the expression can be condensed down to the well-known formula

$$\text{I.H.P.} = \frac{\text{P.L.A.N.}}{33{,}000}$$

Where P=Mean effective pressure (lbs. per sq. in.).

L=Stroke (ft.).

A=Area of piston (sq. inches).

N=Number of working strokes (per minute).

Determining the I.H.P.

To obtain the i.h.p. of an engine the various data must be first obtained. The piston area and the stroke are only matters of mensuration. The number of working strokes per minute can be obtained in various ways, e.g., by means of a counter or similar device. The mean effective pressure is obtained by means of an instrument called an indicator, of which there are many different designs, but they may all be tabulated under two headings:—(1)—Piston type; (2)—diaphragm type. The former consists of a small cylinder which can be connected to the main engine cylinder by means of pipes or such like. A small piston, whose motion is controlled by means of a spring, moves in this cylinder, and by means of suitable levers, etc., a magnified motion of this piston is given to a pencil which is placed in contact with a strip of paper attached to a cylindrical drum. This drum is given a motion corresponding to that of the main engine piston, but reduced to a practical size of from $2\frac{1}{2}$ in. to $3\frac{1}{2}$ in. in length. As a result of these two motions, which are at right angles, the pencil traces out what is known as an indicator card.

The diaphragm indicator is an optical instrument, and hence can be used in very high-speed work, as there are no inertia effects from delicate mechanisms. This instrument consists of a shallow cylindrical box pivoted. The top disc of the box is formed by a thin steel diaphragm to which is attached a small mirror, in the position shown in the diagram. An increase or decrease of pressure in the box will tilt the mirror slightly and thus alter the angle of reflection of a ray of light projected on the mirror. The box is given a rocking motion proportional to the displacement of the engine piston. These two motions being at right angles, the spot of light will trace out a diagram, similar to that of the piston indicator, which can be photographed or traced on a card.

Mean Pressure From Indicator Diagram

To obtain the average length of the pressure ordinates on the indicator cards, i.e.: the mean effective pressure, several means can be adapted: the following, are however, the most common: (1)—By method of ordinates; (2)—By means of a planimeter.

By method of ordinates:—Using the atmospheric line on the card as a base line, draw two lines at right angles, one touching each end of the diagram. Divide the portion of the atmospheric line between these perpendiculars into say 10 equal parts, and at the mid-point of each tenth, draw perpendiculars, cutting the diagram. An easy and accurate method of obtaining the sum of these ordinates is by means of a piece of straight edged paper. First the length of one ordinate is marked on the papers edge, then the paper is moved and the length of the next ordinate marked adjacent to it. By continuing this a result is obtained. The total length is the sum of these ordinates and the mean ordinates of the diagram is total length divided by 10.

By means of a planimeter:—The different types of planimeters which can be used for this purpose are many and hence cannot all be described; the method of using the common area planimeter can, however, be indicated. The instrument is set in the usual way, and the tracer run round the diagram. The reading thus obtained is the area and when divided by the length of the card will give the length of mean ordinate.

In a piston type indicator various springs are used according to type and speed of engine under test. The stiffness of these springs is such that for a certain pressure on the indicator piston, the pencil has a vertical motion of say one inch. In the case of a diaphragm indicator a calibration line is usually put on the first cards. The length of this line corresponds to a certain known pressure, and thus a constant for that particular setting is obtained.

Brake Horse-Power and Shaft Power

It is rather difficult to differentiate between the terms brake horse-power and shaft horse-power. Numerically, they are equal, but the two different terms are applied to the two different methods of obtaining the same numerical result. In the first place the term brake horse-power can be applied when the useful output of the engine is measured by means of a frictional brake or similar contrivance. In the case of shaft horse-power the term can be applied when the useful output is measured by some apparatus other than frictional, connected or attached to the shaft, such as an electrical generator or torsion-meter. Owing to various mechanical difficulties, etc., it is not always possible to obtain the brake horse-power of an engine, especially a large one. There are many contrivances, however, by which this can be obtained, e.g., prony brakes, band brakes, dynamometers.

Brake Arrangement

A prony brake is only used for very small engines, and usally consists of two wood blocks clamped by means of bolts to the engine shaft. Attached to one block is a long lever, from the outer end of which can be suspended various weights. The principle of this apparatus is—that when the lever is floating between the two stops the engine is exerting an equal and opposite turning moment on the shaft.

Thus shaft horse-power=

$$\frac{W\ R\ N\ 2pi}{33,000}$$

Where W=suspended weight (lbs.), R =moment length of lever, N=revolutions per minute.

The arrangement for a band brake is usually applied to a fly-wheel. The principle involved is similar to that of a prony brake, but the method of obtaining the result is slightly different. Consider the initial state when the engine is at rest. If friction, etc., in the engine were eliminated and the weight of the rope and attachments neglected, the spring balance reading would correspond to the weight W. Now it is obvious that when the fly-wheel rotates in the direction indicated, the friction between the band and fly-wheel will tend to lift the weight W, thus the tension on the spring balance will be reduced. When a floating condition is reached it is obvious that the torque exerted by the brake equals the torque exerted by the engine. The brake torque=R (W—SB); where R=fly-wheel radius+half dia. rope (ft.), W=load weight (lbs.), SB=spring balance reading (lbs.)

$$\text{Brake horse-power} = \text{torque} \times \text{space} = \frac{R(W-SB)\ 2pi\ N}{33,000}\ N = \text{r.p.m}$$

There are several types of dynamometers, and they can best be classified under two headings:—(1)—Where the energy is absorbed by means of solid frictions. (2) Where the energy is absorbed by means of fluid friction. The former are not of much practical importance, but the latter can be applied to engines of any size.

In the case of fluid friction dynamometers, the principles involved in the various designs are similar, and the designs only vary in details. The essential features of this type of dynamometer are a series of discs or rotors keyed to a shaft which is coupled to the engine shaft. These rotors are enclosed in a case through which water is circulated. This case is supported on frictionless bearings, and has usually guide vanes fixed inside in order to increase the frictional resistance and thus carry a greater load. As these rotors are rotated, the fluid friction produced tends to rotate the case in the same direction. This is prevented by weights attached to a lever secured to the case. From this it is seen that when a floating condition is reached the turning moment of the engine is equal and opposite to that produced by the weights and lever.

$$\text{This is B.h.p.} = \frac{2pi\ W\ R\ N}{33,000};\ \text{where W=}$$

weights on lever, R=moment length of lever, and N=r.p.m.

The Torsion Meter

The shaft horse-power of an engine is symbolically equal to i.h.p. (frictional losses, etc., in the engine). One of the most convenient ways of obtaining the shaft horse-power of an engine is by means of a dynamo direct coupled to the engine shaft. The current generated may be absorbed in any convenient way, e.g., by a water load, or pumped into the mains. The output voltmeter and ammeter readings are taken and the engine output obtained thus:—

$$\text{S.h.p.} = \frac{V \times A \times 100}{746 \times y};\ \text{where } V = \text{volts, } A$$

= amperes, y = per cent. efficiency of dynamo.

With the advent of the turbine a means of obtaining the output was devised in the instrument known as the torsionmeter. It is a well-known mechanical principle—that the angle of twist in a uniform shaft is directly proportional to the twisting moment applied, provided the elastic limit of the material is not exceeded.

The torsion-meter consists of a comparatively long uniform shaft coupled between the engine under test and the machine which is to supply the necessary braking load. The diameter of this uniform shaft is less than that of the engine shaft, so that the angle of twist may be large enough to be read with a certain degree of accuracy. Close to each end of the shaft are rigidly fastened two large circular discs. The outer edge of one disc is formed by a celluloid scale marked off accurately in degrees. The other disc has a cross-hair eye-piece rigidly fastened to it at the same radius as the scale. To simplify the reading a mirror is placed so as to reflect the image of the scale through the eye-piece outwards. The scale is also illuminated from the back to facilitate the reading of the same.

If the shaft be rotated at a fair speed a permanent ocular image of the hair on the scale will be obtained in the mirror. As a load is applied the shaft will twist and the hair will move relatively over the scale and a new reading will be obtained. The difference between the reading at rest and this will be the angle through which the shaft has twisted due to the load. The shaft having been previously calibrated, the twisting moment corresponding to this angle of twist is obtained and hence the shaft horse-power transmitted.

$$\text{S.h.p.} = \frac{2pi\ T\ N}{33,000};\ \text{where T=twisting mo-}$$

ment in lbs. ft., N=r.p.n.

Electricity and Hydraulics

MODERNISED POWER STATION

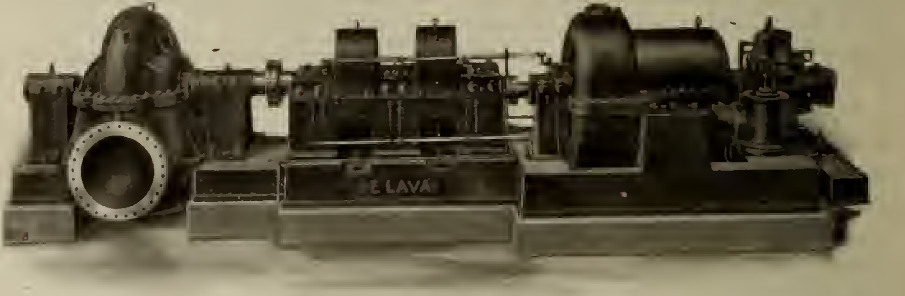
At a recent meeting of the Liverpool Engineering Society a paper on the above subject read by E. M. Hollingsworth, M.I.E.E., M.I. Mech. E., was devoted to a description of the extensions of the St. Helens Corporation electric power station which have been carried out by the author in recent years. Before the alterations were made the plant consisted of four Lancashire boilers, two small water-tube boilers and seven engine-driven continuous-current generators, aggregating 1700 kilowatts, the capital cost, including that of the buildings, but not of the land, being $200 per kilowatt. At that time 2,750,000 units were sold per annum, and the load factor was 26.5 per cent. The capacity of the station is now 7200 kilowatts, of which 6000 kilowatts—O.S. power factor—is modern plant installed at a cost per kilowatt as follows:—

Extensions to buildings, $2.75, boiler plant, rated at 4500 kilowatts, including elevators, conveyors, water softener, foundations and steam pipes, $12.50; generating plant, including turbo-alternators, condensers and foundations, $17.50; cooling towers, 3000 kilowatts, $15; switchgear for generators and four E.H.T. feeders, $1.55; converting plant and switchgear, rated at 2000 kilowatts, $15, or a total off $54.30 per kilowott. At the present time 6,250,000 units per annum are sold and the load factor is 28 per cent.

Plant Constituent

The generating plant comprises three of the old engine-driven generators, one rated at 500 kilowatts and two each at 350 kilowatts, with surface condensers; three high-pressure turbines of the impulse type, with velocity wheels, operating with steam at 170 lb. per square inch, superheated to 520 deg. Fah. and on 28 in. vacuum, coupled to alterators generating 6000-volt three-phase current, 50 periods, at a speed of 3000 revolutions per minute. One has an output of 1250 kilovolt-amperes, another 2500 kilovolt-amperes, and a third set, recently completed, 3750 kilovolt-amperes, with a steam consumption of 13.9 lb. at 75 per cent. of the rated output. The condensers for the turbines are of the low-level jet type, operating with natural draught chimney cooling towers. The water from the condensers is discharged into a small reservoir, from which it is delivered over the towers by motor-driven centrifugal pumps. The primary reason for adopting the jet plant was the trouble experienced with the surface condenser tubes owing to corrosion.

The whole of the continuous-current supply is at present transmitted from the power station, and for this purpose rotary converters are used to transform three-phase current at 6000 volts, 50 periods, to continuous current at 480 to 550 volts. The station is situated near the area of the continuous-current supply for lighting, power and tramways. Most of the energy for lighting and power is transmitted to switch chambers placed at three points of the distribution system, and these chambers have interconnecting feeders. As the use of electricity increases in the particular area it will be necessary to have transformers and converting sub-stations, and to transmit extra high-pressure current as is already done in the case of a remote part of the district three miles from the power station.



DELAVAL CENTRIFUGAL PUMP DRIVEN BY GEARED MULTI-STAGE STEAM TURBINE FOR THE MONTREAL CITY WATER WORKS; TURBINE SPEED 3600 R.P.M.; PUMP SPEED 600 R.P.M.; CAPACITY 30,000,000 IMPERIAL GALLONS PER DAY AGAINST 210-FT. HEAD.

The saving effected by the change is less than was anticipated, owing chiefly to the rising price of fuel; but, notwithstanding this and the short loan period, it is more than sufficient to meet the annual capital charges on both the original and modern plant, and the output of the latter is sufficient to cope with a very considerable increase in the demand.

NEW DUTY RECORDED STEAM-TURBINE-DRIVEN CENTRIFUGAL PUMPS

THE latest record of duty for steam-turbine-driven centrifugal pumps has again been established by a De Laval unit installed in the Low Level Pumping Station of the City of Montreal. This unit has a capacity of 30,000 Imperial gallons per 24 hours against 210 feet head, and on test has developed the equivalent of 168 million foot pounds per 1,000 lb. of steam at 140 lb. gauge pressure and 100° F. superheat, excluding friction head loss through condenser and piping.

The pumping equipment of the Montreal Low Level Pumping Station illustrates the progressive development of waterworks pumping units. The original installation, made in 1857, consisted of a water-turbine-driven pump. In 1868 a steam-driven auxiliary was added, since which the plant had grown steadily, so that it now contains eight pumping units of a total capacity of 108,000,000 Imperial gallons per 24 hours. The earlier units were of the reciprocating type, but subsequently a number of centrifugal pumps, driven by high-speed triple-expansion engines, were installed, and when in 1914 it again became necessary to increase the capacity of the plant, specifications were issued for two engine-driven pumping units, each to be of 12,000,000 Imperial gallons per day capacity. Bids were received at various prices, the duties offered being around 100,000,000 foot pounds per 1,000 lb. of steam. However, the results obtained from the turbine-driven centrifugal pumping units in other cities having meanwhile become known, these specifications were withdrawn, and after an extensive investigation of geared steam-turbine-driven centrifugal pumps installed in different places, conducted by Mr. T. W. Lesage, engineer superintendent of waterworks for the City of Montreal, new specifications were issued, calling for a single turbine-driven pump of 24 million gallon capacity, the contract being ultimately placed with the E. Laurie Company of Montreal, representatives of the De Laval Steam Turbine Co., under exacting specifications, from which the following data are taken:

The capacity was specified as 24,000,000 Imperial gallons per 24 hours, but this was subsequently changed, at the suggestion of the bidder, to 30,000,000 Imperial gallons per 24 hours, as the latter capacity could be secured without material increase in the size or cost of the turbine. The steam pressure was specified as 140 lb. per square inch gauge, with 100° F. superheat. The head pumped against was to be 85 lb. per square inch, plus 5 to 8 ft. suction lift. The bidder was required to state the main dimensions of his apparatus, which, for the De Laval apparatus, were as follows:

Brake HP. of turbine	1600
Number of stages	14
Speed of turbine, r.p.m.	3600
Ratio of gear	6 to 1
Diameter of suction and discharge openings of pump, both	30 in.
Speed of pump r.p.m.	600
Efficiency of pump	Not less than 80%
Weight of complete unit, including pump, turbine and gears	80,000 lbs.
Floor space required approximately	247 sq. ft.

The vacuum was not specified, but the bidder was required to supply the condenser. That offered by the De Laval Steam Turbine Co. was of the so-called "waterworks" type, in which the water passes around the tubes and the steam through the tubes. It was to contain 3,000 sq. ft. of surface, and was to be served by a rotative dry vacuum pump. The condenser was estimated to weigh 36,000 lb. and the pump 7,300 lb., and the two to occupy a floor space of a little more than 100 sq. ft.

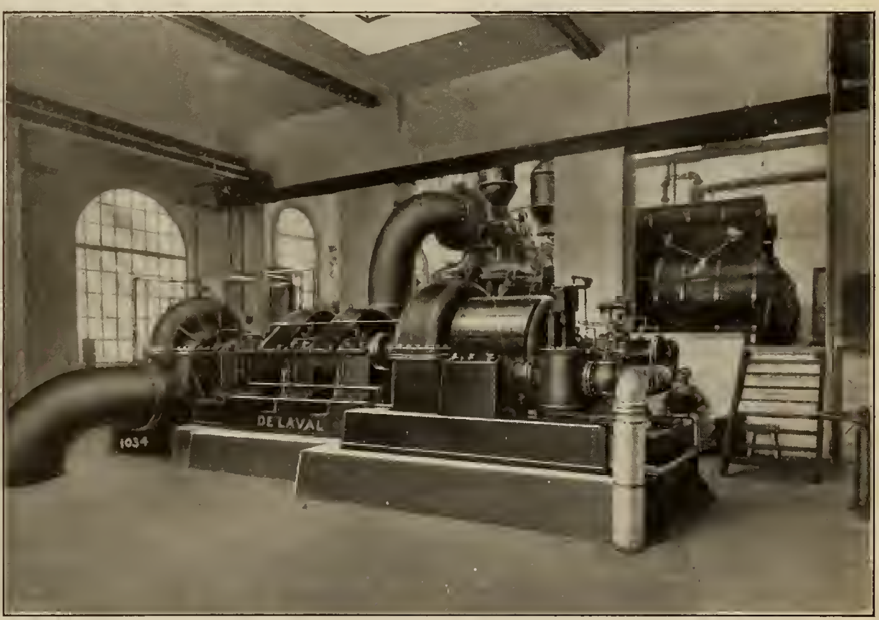
The specifications required that the duty guaranteed should include all losses, including pipe friction, velocity head and steam used by auxiliaries, and it was further stipulated that in determining the duty, the pumping unit should be credited with the vertical distance from the water in the suction well to the centre of the pump shaft, while the discharge pressure would be measured at the point of connection with the city main, corrected to the elevation of the centre of the pump shaft, the pumping unit thus being charged with the friction through the piping, condenser shell, check and gate valves, etc. It was further required that in calculating the duty test, all steam consumed by auxiliaries should be charged to the main unit, the latter, however, to be credited with heat returned to boiler by feed water heaters.

It was required that the unit should be tested to its full capacity at the builder's shops before shipment, and after installation at Montreal should be run continuously for 15 days of 24 hours each without shutting down, at the conclusion of which endurance test, a duty test of 8 hours' continuous running was to be made. In event of failure to develop the duty guaranteed, a deduction of $2,000 was to be made for each million foot pounds by which duty should fall short of the stipulated guarantee.

The following figures summarize the results of the final duty test, which was carried out on October 15, 1915:

Average water delivered per hr., Imperial gal.	1,208,808
Corresponding rate per 24 hrs., Imperial gal.	31,411,292
Average pressure at gage on discharge pipe, ft. head	197.274
Average suction lift from water level to center line of pump	8.6 ft.
Total average corrected head, ft.	205,874
Average water HP.	1.360.85
Steam consumption, lb., per hr., corrected for heat returned in feed water	17,344
Average absolute steam pressure in lb. per sq. in.	159.7
Average actual steam temperature at engine throttle, deg. F.	426
Average superheat at turbine, deg. F.	63
Steam consumption per hr., corrected to contract conditions	16,638
Steam per water HP., lb.—actual	12.7
Duty per 1000 ft. lb. of steam supplied, in million foot pounds—actual	155.356
Duty per 1000 lb. of steam corrected to specified superheat and pressure, in million foot pounds	162.0

In calculating the above duties, the main unit was credited with an amount of steam equivalent to the heat returned to the boilers in the feed water. Part of this heat was obtained from a primary heater in the main exhaust connection and the remainder from an open heater which received the exhaust steam available.



INSTALLATION OF DELAVAL GEARED STEAM-TURBINE-DRIVEN CENTRIFUGAL PUMPING UNIT AT THE LOW LEVEL PUMPING STATION OF THE CITY OF MONTREAL.

During the test, readings of the suction and discharge pressures were also taken at the suction and discharge nozzles of the pump, and the total head based upon these readings was found to be 213.86 ft. Calculated upon the basis of work actually delivered in the water as represented by the product of pressure by volume, the duty would, therefore, be as follows:

Duty per 1000 lb. of steam actually supplied, million foot pounds	161.4
Duty per 1000 lb. of steam corrected to specified superheat and pressure, million foot pounds	168.3

This result represents the highest duty so far obtained by pumping units of this type, and falls little short of the best results obtained with triple-expansion pumping engines costing, including foundations and buildings, very much more than the steam-turbine-driven centrifugal pump.

ELECTRIC CURRENTS FOR POWER PURPOSES

AT a meeting of the Belfast Association of Engineers, an address was delivered by W. Pleasance on "Electric Currents for Power Purposes." He said individual electric drive in an engineering works was undoubtedly the most economical in the end. There was a great deal more in the suitability of the motor to the particular work for which it was required than there was in whether it was three-phase or a continuous-current motor. The introduction of electrical driving was one of the ways, he believed, in which we should have to make good the wastage of capital caused by this war. Properly applied, it enabled the utmost possible to be got out of the man and the machine, and thereby greatly increased the productivity of factories and workshops

DETERMINING EFFICIENCY PLANT OPERATION

By T. W. R.

LARGE heating and power plants should always be equipped with devices for determining the efficiency of operation; otherwise a knowledge of the plant operation is obviously guess work, and no means are available for determining whether the amount of fuel consumed is in correct proportion to the work done. Plants operating as low as 50 per cent. have by the installation and proper use of such devices been materially increased in efficiency with a proportionate decrease in fuel consumption.

Coal Weighing Scales

Scales upon which the coal may be weighed as it is conveyed to the boilers should always be installed. These may be of the platform type with extension beam, the platform being set flush with the boiler room floor so that the coal car or barrel may readily be wheeled thereon. This platform should be placed directly in front of the door communicating from the coal pocket to the boiler room. Preferably the scales should be of the double beam pattern, so that the beam may be placed where desired and the lower member of the beam used for equalizing the weight of the car as tare. In smaller plants a less expensive scale may be used and the coal wheeled up an incline on to the platform. In large plants where the coal is conveyed from the coal pile to the boiler room by means of an overhead trolley, a suspended scale may be used. Both the platform and the suspension scale may be of the automatic type, although this is so expensive as to be advisable only in large plants.

Coal Conveyors

For conveying the coal from the coal pocket to the boiler room a coal truck may be used, having a drop gate on the side of the car next to the boilers. Flat wheel trucks are preferable without the use of tracks, inasmuch as the car can then be taken to all parts of the boiler room and the coal pocket may be placed at any desirable distance from the boilers. For small plants a coal barrow will be sufficient. In large plants the overhead trolley system with dumping buckets may be advisable.

Feed Water Measurement

It is just as important that the water fed to the boilers should be measured as it is that the coal fired under the boilers should be weighed. In some cases a piston type water meter will be found satisfactory, but this only applies to small plants and where the water is not over 150 degrees in temperature. In large plants, and with water at a higher temperature, this type of meter is not likely to be correct or durable.

In some cases, where the water may be weighed without pressure, water weighers will be found satisfactory. More often, water recorders will be found more adaptable and satisfactory, these being made with indicating and recording devices so that the amount of flow can be read at any time, and the total amount recorded on a clock or motor operated dial.

Venturi meters are largely employed for this purpose, and where applied to heating plants, it is usually necessary to apply two tubes, one of which will be of sufficient size to measure the water required for the maximum demand of the boiler plant, and the other of about 25 per cent., to record the flow of water when the plant is being operated at light loads. It is also desirable to have a piston type water meter on the cold water connection to the receiver to measure the amount of fresh water used in the heating plant.

The above equipment, by recording the weight of coal fired and the weight of water fed to the boilers will enable an exact determination of the amount of water evaporated per pound of coal and thereby show the exact efficiency of the plant. If a more refined measurement is required, the fuel must be tested for a determination of its heat value by an apparatus designed for the purpose.

Gauges, upon which are recorded the pressure of each piping system, should be mounted upon a marble gauge board, conveniently and conspicuously located. Recording or combined recording and indicating gauges are desirable as these give a permanent record of the pressures existing at all times. It is customary when installing the gauge board to add a clock in the same style case as is used for the gauges.

Draft gauges may also be employed. They may be applied under or over the grates, and in the smoke connection from the boiler. Such gauges enable the closest draft regulation possible and of course influence the efficiency of the plant.

Fuel Gas Analysis

An analysis of the fuel gases to obtain the percentage of CO_2 therein is most desirable in large plants, but the usual heating plant does not warrant such an installation. CO_2 recording devices are available which will give a correct record of the CO_2 existing throughout the period of plant operation. Theoretically, the CO_2 should equal approximately 20 per cent. of the combustion gases, but practically 16 to 17 per cent. is the maximum. Anything over this is quite as apt to indicate an insufficient rate of combustion, while anything less indicates incomplete combustion, probably because of a too large a supply of air through the grates.

Every plant should be provided with a system of records to determine the complete details of plant operation. These should provide for hourly readings of coal consumed and other details, making use of a simple form of log sheet.

CROSSHEAD TYPE DIESEL ENGINE

AT a recent meeting of the Diesel Engine Users' Association Chas. Day, discussing the crosshead type of Diesel engine with forced lubrication, said the principal reasons which had up to the present operated adversely in regard to the adoption of this type of engine were its extra cost and its increased height as compared with the trunk piston type.

Referring to its advantages, he said these were, in the first place, the greatly reduced risk of piston seizing due to the fact that the piston need not be such a close fit, as the transverse forces due to connecting-rod angularity were taken on the crosshead and not on the piston. He pointed to the fact that piston seizing in the case of the trunk type of piston was often caused by the distortion of the piston due to irregular sections or to the expansion of the piston pins. There was also reduced risk of piston cracking, and it was possible to give much better support in the crosshead type than in the trunk type to the centre of the piston, which was exposed to the greatest heat and to the maximum stress. There would also be reduced trouble with the connecting-rod top end, since this bearing was in a position quite away from the heat of the piston.

Lubricating Oil Economy

To further secure that the piston rod should be kept cool, and to prevent any oil vapor rising from the crank chambers to the cylinders, or any smoke or dirty oil passing into the crank chamber, a cover was fitted between the cylinder and the crank chamber, this cover being fitted with a water-cooled gland which also prevented transmission of heat to the crosshead. A further important advantage claimed for the crosshead type of engine was greater economy in lubricating oil, as any carbon or dirty oil is prevented from entering the crank chamber from the cylinders, and the lubricating oil therefore retains its condition longer. The lubricating oil, not being splashed or thrown on to the cylinder walls, was kept much cooler, and none of it being lost through the cylinders, a substantial saving would obviously result. The air on its way to the cylinders was arranged first to go underneath the pistons so that any smoke or gas which had passed the pistons would be thoroughly cleared away, and a considerable amount of air cooling would also take place. The water-cooled gland would have none of the disadvantages of a water-cooled piston since it did not introduce any additional reciprocating weight, and its stationary water joints would not be liable to cause trouble.

A point which might be raised in the crosshead type of engine, viz., that the reciprocating weights would probably be greater, could be overcome by careful attention to design, since piston used need not be made so thick and heavy as in the case of the trunk piston, which was liable to cracking and distortion if its thickness or weight were further reduced.

MOTORS IN SERIES

By E. C. Parham .. .. ..

SO far as the current-limiting effect in a circuit is concerned, a counter e.m.f. acts the same as a resistance except that it does not waste energy as does a resistance. Also, as in the case of series resistance, if a circuit includes two counter e.m.fs., the sources of which are connected in series, the applied e.m.f. of the circuit will be distributed between the counter to their respective values, the larger voltage drop taking place across the greater counter e.m.f. If the values of the counter e.m.fs. change so that one becomes far greater than the other, then the voltage drop across the counter e.m.f. of negligible value will become negligible and practically all of the applied voltage will become located across the counter e.m.f. of increased value.

An electrical repairman who had been getting rather unsatisfactory power service from a low-head waterwheel concluded to try the power from the city 220-volt service. He had available two 110-volt motors which he belted independently to the countershaft, the motors being connected in series and to the same starting box. On applying voltage, both motors immediately started but one of them gradually slowed and stopped while the other motor began to race.

The shifting of brushes and the tightening of belts helped matters somewhat, but in order to secure operation that was at all tolerable the belts had to be drawn so tight that the bearings heated. Taking as a cue the improvement effected by the tightening of the belts, he set the motors end to end and coupled their pulleys together so that whatever happened to the speed of one armature had to happen to the speed of the other. Operation then proved to be satisfactory, for, by shifting of the motor brushes, the voltage drop of the motors could be made the same, thereby equally dividing the work between them.

The irregular action obtained in the first place can be explained as follows: Assuming an initial slight difference in the counter e.m.fs. of the two motors, due to a slight difference in speed for example, the greater counter e.m.f. would absorb the greater part of the line voltage. This would increase the speed of the higher speed motor which would further increase its counter e.m.f. and, simultaneously, the speed and counter e.m.f. of the other motor would be decreased. These effects were accumulative, so that one speed gradually became a condition of racing while the other gradually approached zero.

ECONOMICAL HANDLING OF CRANE MOTORS

IN a recent issue of the General Electric Review there appeared the following query and answer to same. As motor driven cranes form an important feature in at least large and medium size metal-working plants, and as the tear and wear of the motor enter prominently into the substance of the query and its answer, the latter will be found worthy of a fair measure of study and attention from those responsible for directing and carrying out the particular service operations required of the machine.

Which of the following methods of handling a crane motor will effect the greatest possible saving in current consumption? (a)—To bring the motor up to speed as fast as possible without abusing it. (b)—To bring the motor up to speed slower than described in (a) by making a decided pause on each point of the controller.

The method which will be the more economical depends largely upon whether the motor is a direct or an alternating-current machine and upon the type of controller used.

For example; a series-wound direct-current motor with a standard reversible rheostatic controller will require a smaller consumption of power if method (a) is used, for two reasons:

(1)—The torque per ampere of the motor is greater when its fields are fully saturated by a large amount of current than when not so fully saturated, therefore, the work will be accomplished in a time that is proportionally shorter than the increase of current.

(2)—When controller is advanced as rapidly as possible without injuring the motor, the work of starting motor is performed in the shortest practicable time; therefore, current is being dissipated in the rheostat for a minimum time only. Of course, the average value of the current taken by the motor through the rheostat during the starting period will be greater for method (a) than method (b), but it will usually happen that, in the apparatus under discussion, the "time" factor of energy consumption has a greater influence than the "current value" factor.

For an alternating current motor the reasoning given in (1) and (2) would apply only to a limited extent, because, when this type of motor draws about 200 per cent, normal current or more, its torque-per-ampere efficiency will be much less than for a current nearer its normal rating, therefore, whatever will be gained by diminishing the rheostatic losses will be sacrificed by an increase in the motor losses. The least possible total current consumption at starting will as a consequence, probably be secured when the controller is advanced just rapidly enough to cause a flow of from 150 to 175 per cent. full-load current.

On direct-current series-wound motors the split-circuit type of dynamic braking controller will give results for hoisting similar to a straight direct-current series-wound motor, and for lowering results similar to an alternating-current motor. The power consumption reasoning that applies to machines of these types has been stated in the foregoing.

FLASHOVERS ON COMMUTATOR

The owner of a 250-volt continuous-current motor, says E. C. Parham in the General Electric Review, concluded to rewind it for 500-volt service, so that he could obtain power from a railway circuit. Accordingly, the armature and the field coils were rewound. After the rewinding, the motor always operated normally at no-load and most of the time it gave no trouble when operating under load, but frequently when continuous operation of the motor was most urgent it would flash over; this generally meant blowing of the breaker and delaying production. Finally, as the result of the railway company putting on heavy cars which produced violent fluctuations in the line voltage, the interruptions in the operation of the rewound motor became so frequent as to be intolerable.

The owner then consulted the manufacturer of the motor to find out what was the trouble. He stated the history of the motor fairly; and he was informed as follows: "Almost any motor will flash at the commutator if the voltage impressed on it is greatly reduced and then is suddenly raised to its former value. In this particular case the sparking conditions were aggravated by the mistake of having greatly increased the number of turns in the armature winding (to meet the requirements of the increased voltage) without increasing the number of bars in the commutator." As a relief measure, he bought a new armature and sent the old one to the factory for a new commutator. This did not entirely eliminate flashing, but it greatly decreased the frequency of its occurrence.

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THE BUSINESS OUTLOOK

INDUSTRIAL conditions continue to show steady improvement, the immediate and future outlook being, generally speaking, such as to engender and foster optimism. Canadian business enterprise is perhaps on a more stable basis than at any time in its history, and is marked by a caution that augurs well for its permanent maintenance in that respect. While the possibilities of developing an export trade have been fully realized for many months now, we have only recently taken active measures to get into touch with it, a circumstance, however, that is in no sense indicative of tardiness, but rather expressive of the already-mentioned caution and desire to fit and adapt ourselves to one or more of the trade opportunities that the war has made available.

In this connection it may be stated that not a few of our steel mills and allied enterprises are already taxed to the limit of their capacity on export business, the latter embracing practically every country in the world with the exception, of course, of enemy countries. The effect in these instances has been to create a commodity scarcity as regards domestic requirements, and have the natural consequence of causing increased prices in the latter sphere. However, if the export campaign as it develops intensity, works out as successfully as anticipated, it will not only lead to the maintenance of a favorable trade balance after the war is over, but will offset any tendency to a reactionary period which might be expected to set in immediately peace is declared.

The steel market, which after all is the real barometer and foundation of the industrial activity of this or any country, continues to maintain strength, the demand for steel being as insistent as ever. Our own mills as well as those of the United States have all the business they can handle for this and a large slice of next year, and, in saying that much, we are far from straining the situation. A shortage of labor is the present handicap, and the immediate outlook is that manifestation of the latter may become more aggressive. The upward price tendency of practically all manner of commodities continues, and indications are that we are yet some distance from the peak.

The question of scientific and industrial research is engaging the attention of many of our manufacturers who, until the matter was forcibly impressed upon them by the commercial upheaval since hostilities started, did not appraise at its full value the wonderful development of enemy technical education.

It is more than desirable, indeed—it is imperative that our manufacturers strengthen their impending entry into world-wide markets by availing themselves of all possible sources of information, means of research, and methods of organization. The sources of information available to our competitors, but no matter how much exclusive information any of our manufacturers may be able to obtain, it will be but of negative value if not vigorously applied to active production and progressive development.

THE C.A.S.E. CONVENTION AND GRADED CERTIFICATES

IN another section of this issue will be found the preliminary programme in outline for the coming convention of the Canadian Association of Stationary Engineers, to be held in Montreal. That city is the hub of big things commercially and industrially, therefore it is only natural to find that its local C.A.S.E. lodge is bent on keeping up to the reputation of the above-mentioned features, so far as the convention is concerned.

For several months a discussion—animated at times, but nevertheless reasonably suggestive of the constituent of engineers licenses, has had a place in our editorial columns, from all of which we gather that the desire for graded licenses is well nigh full-fledged. It must be admitted, however, that in respect of machine shop experience being essential to a graded arrangement, a sharp difference of opinion exists. Doubtless the subject as a whole will be prominent in the deliberations of the coming convention.

Graded certificates are, it seems to us, mentime, possible of being made available without reference to a machine shop apprenticeship or experience, the great scope of the work, the opportunities for acquiring knowledge and the natural aptness or otherwise of individual operators, easily providing three or more excellent standard ratings. Men in all trades and professions, at least those who serve, and most of us partake of this privilege, are possessed of natural certificates of competency, independent altogether of any parchment or title bestowed by a university, board of examiners, employer, or other such society or individual. It, therefore, seems contrary to all the principles governing human intelligence and existence that there should be other than a step ladder provision for stationary engineers which will not only have distinguishing levels, but will, in a brief space, require lengthening in order to reach some still higher plane.

Graded certificates may not, we are aware, secure for the various holders their heart's desires, but they certainly will provide a most powerful incentive to individual efficiency and expertness in the performance of the duties of the operator's chosen calling. In every great and successful movement its leaders realized the surety of failure in attempting to compass their ideal en masse. They therefore established a common platform to begin with, on which all the varied and otherwise opposing interests could meet, leaving individual and sectional adjustments for later consideration. In like manner, operating engineers in those provinces of the Dominion where graded certificates are non-existent would do well to begin with enactment on a non-controversial basis—one certainly exists; then on the broader question of interprovincial exchange—largely on which account the machine shop experience bugbear has arisen, there is little fear but that an acceptable, all-Canada-embracing series of ratings would require only a brief period to evolve and put into effect.

The Operators' Point of View

CONDENSER APPLICATIONS

By E. Newman.

THE purpose of attaching a steam condenser to a reciprocating engine or turbine is to increase the effective range of pressure by creating a partial vacuum or pressure lower than that of the atmosphere at the exhaust end of the unit to which it may be applied. Increasing the range of pressure in a reciprocating engine would mean a corresponding increase in power output, but if this were not desired, the same output could be secured by cutting off the steam earlier in the stroke, and thus save the steam nearly in proportion as the cut-off is reduced.

With a turbine there is a more marked saving than with an engine, as it is possible to design turbines to take advantage of a greater number of expansions of steam than can be had within the limits of initial and final pressures. With a reciprocating engine the number of expansions is limited by the high cost of cylinder sizes necessary, also cylinder condensation, etc.

With turbines a large part of the work performed is between the limits of atmospheric pressure and the vacuum at exhaust, 28 inches vacuum or 1 lb. absolute being about the pressure called for in average turbine practice, though when high economy is being sought 29 inches and even 29½ inches have been called for.

Vacuum in Reciprocating Engines

Average reciprocating engine practice has proved that there is little appreciable advantage in carrying a vacuum greater than 26 inches or 2 lbs. absolute. It is true that a higher vacuum will enable the engine to produce more power, but the gain will be at the expense of handling a greater volume of condensing water, and the increase cost of pumping this water offsets any gain attained with a lower vacuum. The steam required to drive independent steam-driven air and circulating pumps will average about 6 per cent. to 10 per cent. of that used by the main engine, depending upon the size of the latter. With turbines these figures are somewhat less.

The steam used for driving these pumps may be taken from their exhaust to the feed water heater, preferably through an oil separator, and used to warm up the feed water, before the latter is fed to the boilers. Exhaust steam from the boiler feed pumps and any other auxiliaries should also be run through the heater, thus helping to raise the temperature of the feed water coming through the air-pump from the condenser, which may not exceed about 110 degs. F. on account of the vacuum. The feed water temperature may, by means of these auxiliaries be raised to, say about 180 degs. F., according to whether the steam required for them is great relatively to that of the main unit.

Condensing and Non-Condensing Comparison

With a non-condensing engine, the feed water may be heated by the exhaust steam to approximately 200 degs. F. when engine is exhausting at, or near atmospheric pressure; therefore, the saving in coal used by the main engine due to a condenser is somewhat counterbalanced by the higher feed temperature due to running non-condensing.

With feed water taken from condenser discharge at a temperature of 110 degs. F., there would be a loss of approximately nine per cent., as there is a gain in efficiency of one per cent. for about each 10 degs. F. the feed water is heated. Should the auxiliaries bring up the feed water temperature to about 180 degs F., then the loss would only be about two per cent. This is so small a difference between the two systems that it can almost be neglected in considering the saving due to the use of the condenser.

It is fairly safe to assume that a condenser under the normal working conditions for which it was designed, will reduce the fuel consumption from 20 to 25 per cent., and it can be applied to any type of reciprocating steam engine, whether cut-off or throttling, where a sufficient supply of cold water is available, and the exhaust steam is not needed for heating or manufacturing purpose.

Type of Condensers

There are three general types of condensers, the jet condenser, the surface condenser, and the barometric or syphen condenser.

The jet condenser consists of a closed chamber into which the exhaust steam is led and into which a spray of cold water is injected, and, as the two come together the steam is instantly condensed. As a cubic foot of steam at atmospheric pressure will make but one cubic inch of water when condensed, there will be created a vacuum or empty space in the condenser chamber, thus removing the resistance or back pressure.

There will always, however, be carried over into the condenser chamber some entrained air along with the injection water, and also with the steam, but probably the greatest cause of air may be accounted for by reason of leaks in the connecting pipes and from leaky stuffing boxes. There is generally also, more of these with a reciprocating engine than with a turbine unit.

This air would, of course, collect until the vacuum were destroyed if no means were provided to remove it. To get rid of it is the object of the air pump, which has its suction pipe connected to the condenser chamber, and by its action withdraws the air heater vapor and water. The vacuum can never be perfect because the cold water admitted for condensing the steam is heated by the steam and emits a vapor whose tension is such that when the ordinary barometer indicates 30 inches at sea level the vacuum gauge will stand at about 27 inches. Jet condensers require less water than surface condensers. They also require very little foundation and take up less room than surface condensers. Being independent the vacuum can be created before starting the engine.

Jet Condenser and Boiler Feed

If it is intended to use the water for boiler feed purposes it must not be salt or dirty. The height of the condenser above the source of the injection water should be as little as possible, a distance of 18 or 20 feet ought not to be exceeded and should be less if conditions permit. For high suction lifts of injection water, an overhead supply and priming valve would be of advantage in starting the condenser, but this supply should be shut off as soon as the vacuum is created, as if this valve were left open, the condenser chamber would be flooded, thus destroying the efficiency of the vacuum-breaker and possibly allowing water to be drawn into the engine cylinder.

A thermometer in both steam exhaust inlet and air pump outlet will be found useful by indicating the temperatures and consequently the pressures being attained. If the air pump outlet shows too low a temperature, probably too much injection water is being pumped, and the supply might be cut down a little until the discharge temperature is about right, say until 110 degs. F. for 26 inches vacuum.

Injection Water

The quantity of injection water required will vary according to the vacuum and the temperature of the supply. If the water supply is from a well, the temperature will be more nearly constant over the whole year than if drawn from a stream. The amount of injection water may be found as follows, assuming 26 inches of vacuum, injection water temperature of 50 degs. F., and a discharge temperature of 110 degs. F.

$$Q = \frac{(H+32)-T}{T-t} = \frac{1,147-110}{110-50} = \frac{1,037}{60} = 17.3 \text{ lbs.}$$

Where Q = quantity in lbs. of water per pound of steam condensed water per lb. steam = $1\frac{3}{4}$ Imp. gallons.

T = discharge temperature in deg. F.

t = injection water temperature deg. F.

H = total heat in each pound of steam to be condensed of the steam at condenser pressure.

Condensing engines and condensing turbines should always be supplied with an atmospheric exhaust relief valve as a safety precaution in case of anything going wrong with the condensing apparatus, such as air pump failing to operate or losing the injection water for any reason.

If the air pump goes out of commission, the pressure rises in the condenser chamber and thus opens the atmospheric relief valve allowing the engine to exhaust freely to atmosphere until such time as the pressure in the condenser chamber decreases and the vacuum is again created when the valve closes automatically. Another precaution is to place a gate valve in the pipe line between the engine and the condenser in order that the engine may be kept running whilst repairs are being made to either air pump or condenser.

* * *

A DANGEROUS ENGINE

By N. G. Near

A gas engine "ranaway" for some reason or other it got too much gas. The engineer ran to the throttle, closed it, but the engine didn't stop, the valve was imperfect, by-passed the gas, and the engine ran faster than ever. Finally a connecting rod broke, one of the pistons "dug into its cylinder" and with a few other parts broken or sprung out of place the engine came to a stand-still.

Autogenous welding, a forge, and a few new pieces fixed the engine so that it was "good as new," but the original owner wouldn't run it any more. He was afraid of it for it was liable to do the same thing again, so he thought.

The engine is now doing duty in another town a thousand miles from where it ranaway. It was sold at a very low figure. The new owner does not know the engine's past history. If he knew perhaps he too, would sell it, and perhaps he wouldn't.

The first owner is pleased because he got rid of a dangerous piece of machinery. The present owner is pleased because he got the machine at a low price. Is it RIGHT to sell a machine that you consider unsafe.

* * *

STAGGERED VS. UNSTAGGERED METAL LACING

By W. F. S.

METAL and wire lacings are so much the style now-a-days that it is perhaps well to have them discussed more freely, we don't read enough opinions on such lacings.

I notice that there are two types of hook arrangement—staggered and unstaggered, I prefer the staggered type because theoretically it should be stronger. The staggered type is stronger for the same reason that the staggered riveted boiler joint is stronger and more efficient than the single-line of-rivets type.

The principal drawback to the staggered metal lacing is the fact that staggering increases metal width and makes the joint stiffer; it being, of course, as well, always, to have as pliable and smooth a joint as possible. Belt joint efficiency is computed in about the same way as is boiler joint efficiency, therefore, for proof of the above arguments, readers are referred to boiler joint formulae.

* * *

LICENSE LAWS FOR ENGINEERS

By R. McLaren.

WITH regard to my statement that Watt had no shop experience, I may say that the Encyclopedia Britannica is my authority. Watt was born about the year 1736. At the age of 19 he went to London to learn the trade of philosophical instrument making. On account of poor health he could stay only a year at it, but in that time gained a fair knowledge of the trade and became handy in the use of tools.

He returned to Glasgow in 1756, and the professors of Glasgow College gave him work repairing astronomical instruments. He tried to establish himself as an instrument maker in Glasgow (I said in a former letter that it was in Edinburgh, that was wrong), but the guilds there forbade him to do so, not because he did not know his trade, but because he had not served the full term of apprenticeship of probably seven years.

Apparently the college professors thought that an injustice was being done, for they established him with the title of mathematical instrument maker to the college. In 1764 he was still there, for in that year his attention was seriously drawn to the steam engine by having a model of Newcomen's engine given him to repair. This model was part of the college collection of scientific apparatus. The foregoing, I believe, answers Mr. Scott's questions.

Non-Shop Experience Examples

Of the shop experience required by some engineers' license laws, Watt had none. I might also have stated in my former letter that Thomas Savery, who had something to do with the development of the steam engine, was a military engineer; Newcomen was an ironmonger, and George H. Corliss was a storekeeper. Why didn't someone ask Corliss how a man can be an engineer without shop experience? It might have kept him at storekeeping.

The possession of shop experience does not always prove that a man understands the operation of a machine that he can build and repair. Less than two weeks ago a man asked me to explain the working of a twin double-acting power pump. He said that he had made every part of various pumps, but wished some one would explain how the blamed things worked.

College Men Involved

I believe that the best medicine a man can take in order to become an engineer is a combination of practical operating experience and theoretical instruction. Right here it might be as well to state that engineers who have acquired their training in the engine and boiler room are not the only ones who are interested in the shop experience clause. Graduates of schools of science and of technical schools are also involved. Men who have graduated from these institutions and have added practical to their theoretical knowledge may not operate plants controlled by the shop experience clause, even though they may have graduated with honors, etc.

A mutt who has "worried" in the required number of years in a shop, and who can graduate from the examination with "horrible mention," is legally qualified to beat them to it. The excuse that the clause is for the purpose of safeguarding employers against ignorance and incompetence is nonsense, and is put forward to hide the real motive, which is to hog tie and brand the engineering profession for the benefit of a particular class.

Such legislation ought to be avoided. It makes us look dishonest. A sample of similar legislation is as follows:—In a city not far from Toronto the engineers got the city council to pass an ordinance making one year's residence in the city necessary before a man could operate in the said city. Of course, it was unconstitutional and absurd, and its motive was apparent. The same motive prompted a good man to pray God bless me and my wife, my son John and his wife, us four and no more.

PIPE AND PIPE FITTINGS

By J. E. N.

IRON pipe and its fittings, together with their erection and installation play no insignificant part in stationary, steam engineering, but personally I believe the subject as a whole gets less consideration in the technical press, especially in the correspondence section, than do much less important apparatus and equipment.. Some engineers and many helpers are lamentably deficient in knowledge along this line.

A short time ago I was doing some repair work in a plant. I asked the engineer to go to a dealer and get me six $1\frac{1}{2}$ inch lock nuts. After being away for some time, on his return, he informed me that he had tried several dealers and that none of them knew what "octaves" were. He had taken up the word lock nuts wrong, which indicated that he was ignorant of pipe fitting work else he could not have made the mistake.

Many engineers do not know that, in specifying the sizes of reducing tees, the ends are stated first and the centre last; others again study their pipe lines so carelessly that they require a pair of calipers and a rule to find out the sizes. In any case every operator should be able to state the size of pipe or fitting by glancing at it.

Cast Iron Fittings

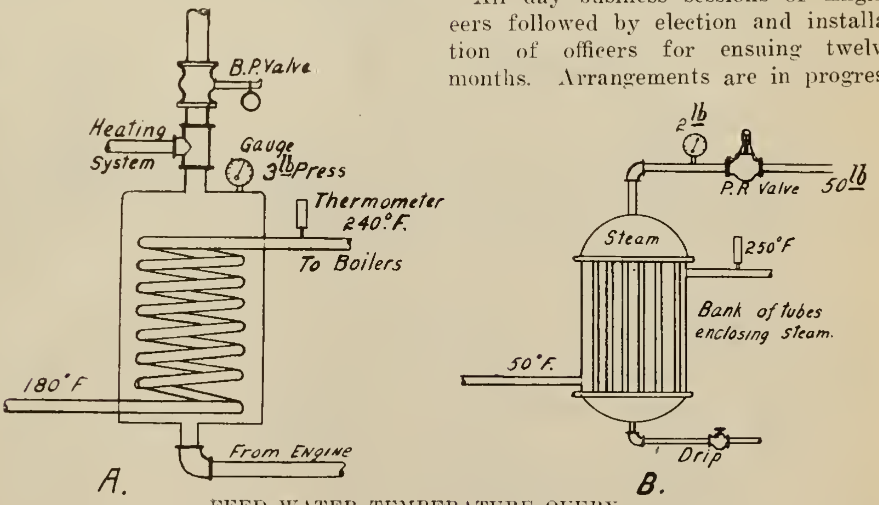
It is good policy to use cast iron fittings on water and gas lines, and on ordinary steam pressure lines which do not come in contact with fire. In steam work it is absolutely necessary to see that the pipe line is properly supported and that ample provision has been made for expansion or contraction. Cast iron fittings will outlast malleable cast and cost less. If there is a line of piping close to a wall or corner and it is required to put in a branch, a cast iron fitting can be broken and a branch and union put in with little trouble. On the other hand, if a malleable fitting happen to be installed, considerable trouble may be encountered in cutting the pipe. In running a pipe line use proper reducing fittings at the branches; do not use bushings as they are unsightly and are the source of many leaks. A study of a pipe fitting catalogue will give a good working knowledge of valves, hangers, and all the different classes of fittings used in pipe work.

When taking down old pipe lines, it is almost a certainty that some of the fittings will become cracked. Do not throw any such cracked fitting aside until you have broken it apart, otherwise you may install it by error in a pipe line at some future time and of course it would mean trouble and removal again. In any case it is the right thing to carefully examine and sound all second hand fittings before using them at any time.

In running a long line through narrow tunnels, etc., it might be a good plan to install a ground face union or flange coupling at several points. The chance of a leak with these fittings is small and it may save considerable trouble and expense later, if it should become necessary to put in other branches or replace old ones. The use of cotton wick or hemp on threads is all right for water or coal gas, but it should never be used on steam work as it will burn out and cause a leak. Use graphite and oil. Red lead with boiled oil makes a permanent joint or one very hard to disconnect at any future time.

READER'S QUERY

ON at least two different occasions I have been asked to explain this paradox. I cannot do so, and am, therefore, submitting the questions in the hope of some reader being able to shed light on the subject.



FEED WATER TEMPERATURE QUERY.

(A) An engineer operates a feed water heater, "closed" type. The heater receives exhaust steam at 3 lbs. pressure. The feed water enters the heater at 180° F. and leaves at 240° F. Where does the water get the extra 18-20° F. from?

(B)—The demonstrator takes the water from city mains into heater, "closed" type, at 45-50° F. The water leaves the heater at 250° F. The steam (live) passes through pressure reducing valve and the gauge shows 2 lbs. pressure. Where does the water get the excess temperature, 250—219=31° F. from? The sketches show actual arrangement tried in case A and all registered about the same heat. The gauges were not tested. In case A, of course any great difference in pressure would, of course, be manifest on the engine.—R.T.

C.A.S.E. CONVENTION

THE following tentative programe has been arranged for the Annual Convention of the Canadian Society of Stationary Engineers which takes place in Montreal during the week of July 24. The convention meetings and exhibit will be held in the Technical School Buildings.

Monday, July 24

The official opening will take place at 10 a.m. on this date, the Mayor of Montreal and the Provincial Minister of Public Works participating. All exhibits are required to be in place and arranged by 12 o'clock noon, at which time the exhibition will open.

Tuesday, July 25

While the engineers are in session, the lady guests will in the morning be treated to an automobile ride in and around the city, and to a car ride and visit to Dominion Park in the afternoon.

Wednesday, July 26

Engineers in session during the forenoon; Exhibitors' Association Picnic in the afternoon, and entertainment at Exhibition Hall, in the evening.

Thursday, July 27

All day business sessions of Engineers followed by election and installation of officers for ensuing twelve months. Arrangements are in progress for some form of entertainment in the evening.

Friday, July 28

Closing exercises and get-away day.

Operators' Instruction Course

THE STEAM BOILER—V.

THE subject matter of the accompanying article of this series on the steam boiler—some elements of smokeless furnace design, is from a paper read before the Ohio Society of Mechanical, Electrical, and Steam Engineers, by Osborne Monnett, mechanical engineer the American Radiator Co., and formerly chief smoke inspector, Chicago, Ill. Smokeless combustion of fuel is of live interest to steam power engineers of every class and grade, not only from the professional achievement point of view, but because also of the public attitude, which is growing in intensity against the uncontrolled emission of black smoke from our factory, power plant, locomotive and steamship stacks in or near our cities and pleasure resorts. The author we might say is in the very front rank as an authority on the subject and his aim in what follows is to call attention to the characteristics of a few conventional settings which have been used in the past, and to point out ways in which they may be improved from a smoke standpoint for territories using high volatile, long flaming coal.

High Pressure Power Boilers

With the many types and shapes of boilers on the market to-day, boiler practice gives opportunity for innumerable combinations of stokers and furnaces. The type selected, either of boiler or furnace does not have as much bearing on the smoke performance as does the manner in which the combination is put together. It is sometimes quite a problem to get a boiler and furnace connected in such a manner that both will have a chance to give the best results.

Chain Grate.—Plate I. Fig. A, shows in outline an old type chain-grate setting with a 3½ foot ignition arch, the stoker being set under the boiler with a clearance of 6 feet from floor to front header. This setting is typical of the older practice in chain-grate setting, with low, short, flat arch, poor ignition and low capacity. Such an outfit cannot be considered smokeless when carrying any considerable load. The deadening effect of the bank of tubes is such as to extinguish the flame before combustion has become complete, in the same manner that a wire netting will kill the flame from a gas burner, the result being a great deal of smoke. While this setting gives very short flame travel, it must not be inferred that mere length of flame travel is always enough to insure a satisfactory setting. It has been found that on a long gas pass, unless some positive means are taken to cause a mixture, the gases frequently become stratified and do not mix, in which case the combustion cannot be complete.

In Fig. B, plate I, the boiler has been raised to 10 feet under the header; the ignition arch lengthened to 5 feet and set full extension. This allows more flame travel, but the setting still has some of the defects of the first one and is not good for high capacities. One of the principal defects is that the flow of rich volatile matter may pass into the bank of tubes in an uninterrupted current in the front part of the furnace, while most of the oxygen necessary to burn this volatile matter is passing in at the back part. There is a lack of mixture and consequently incomplete combustion and low economy.

Fig. C, plate I, corrects the above defects by using a longer arch, setting the stoker farther under the boiler, decreasing the floor space occupied and narrowing up the furnace throat opening so that the volatile gases and air mix in a high temperature zone, which easily completes combustion on a 10 ft. setting. Experiments have been made to determine the best throat opening for commercial use. Openings from 18 in. to 36 in. have been tried with success, the smaller ones being high in maintenance; 30 in. is about the most satisfactory opening for all around use.

Another factor, which has had a marked effect on the performance of the later chain-grate settings, has been the height of the ignition arch at the gate; where 11 in. was formerly the standard height for a flat arch, it has now been increased to 15 in., and the slope of the arch has been increased to 2 in. or 3 in. per ft. Where the arch is sprung across the furnace, it is now set level, 9 in. above the grate at the skewback, with a 9-in. spring, making 18 in. in the centre of the arch.

For the horizontal baffle little need be

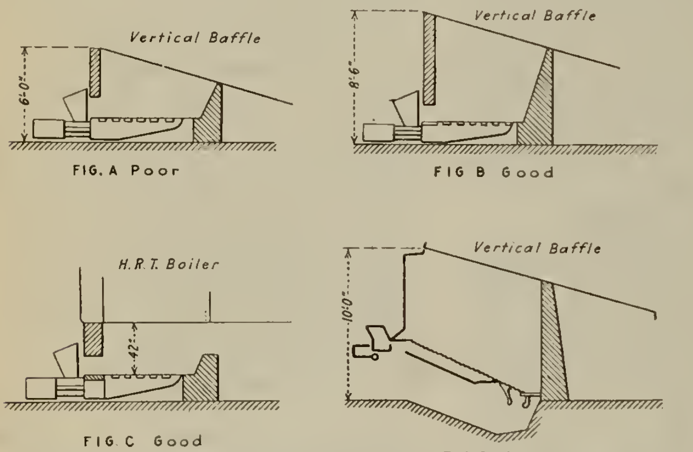


FIG. A Poor

FIG B Good

FIG. C Good

FIG. D Good

PLATE I. SOME CHARACTERISTICS OF CHAIN GRATE SETTINGS.

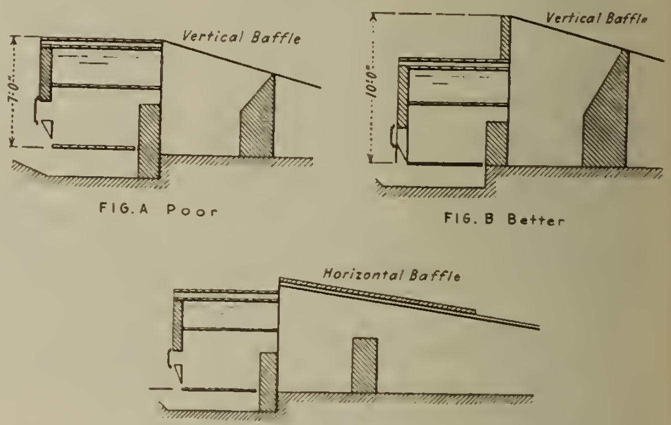


FIG. A Poor

FIG. B Better

FIG C Better

PLATE II. DOUBLE INCLINED STOKERS AND HORIZONTAL WATER TUBE BOILERS.

said from the smoke standpoint as this combination is always satisfactory. Fig. D, plate I, shows a setting with 7 ft. 6 in. head room, which can be considered ideal for a chain grate. This dimension may vary considerably without affecting the performance, and 6 ft. 6 in. may be considered the minimum head room allowable.

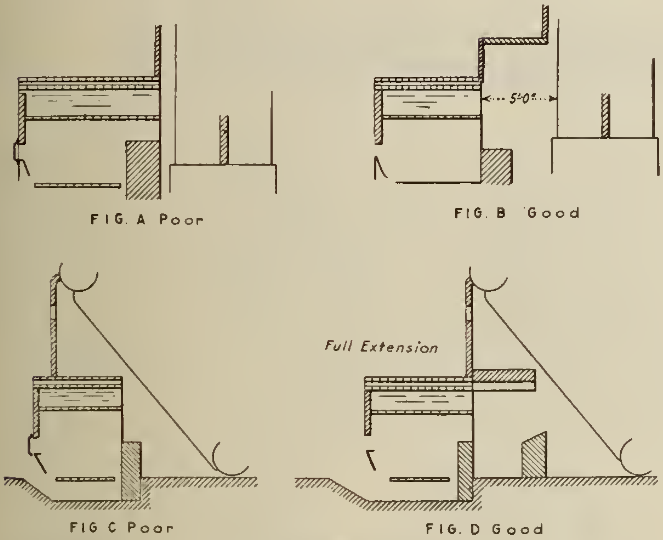


FIG. A Poor FIG. B Good FIG. C Poor FIG. D Good

PLATE III. DOUBLE INCLINED STOKERS AND VERTICAL BOILERS.

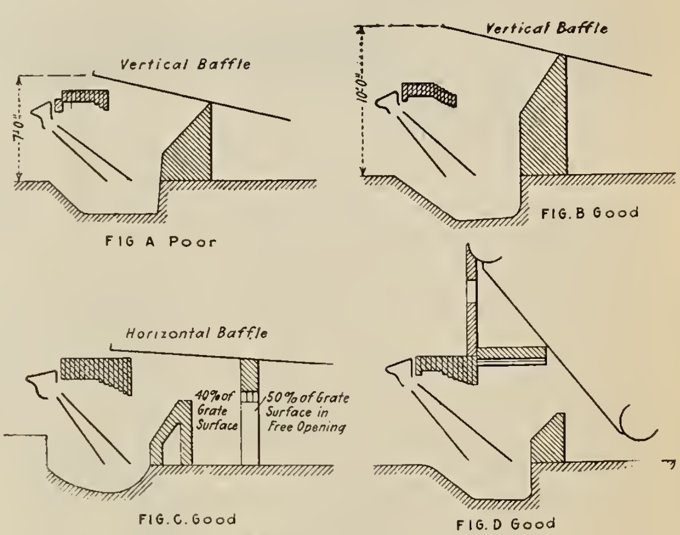


FIG. A Poor FIG. B Good FIG. C. Good FIG. D Good

PLATE IV. COMBINATIONS OF FRONT FEED STOKERS.

It sometimes happens that, with a tile-roof furnace and a low setting, the furnace gets so hot as to have a bad effect on the life of the brick work. This can be offset in many instances by baring the lower row of tubes, using T tile instead of box tile. This allows more rapid heat absorption into the boiler, increasing the life of the brick work and resulting in a better operating furnace.

Double Inclined Stokers.—For the double inclined type of stoker, the short length of flame, discharging directly into the bank of tubes is undesirable when the fire is being worked. This type of setting is frequently found installed in a 7-ft. head room as in Fig. A plate II.

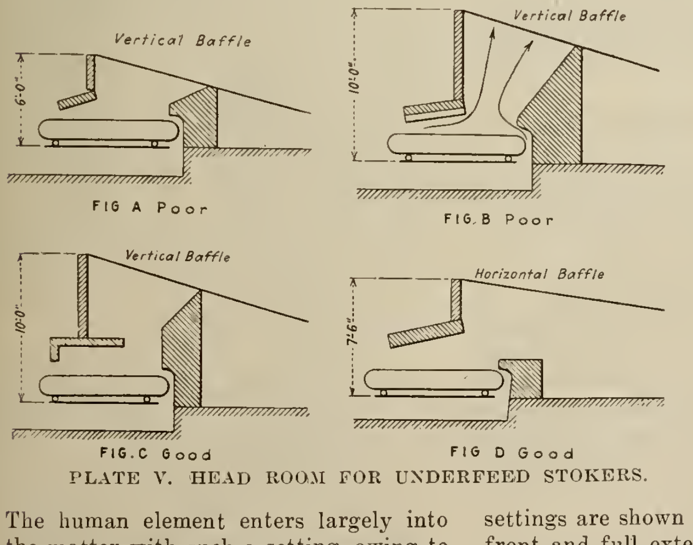


FIG A Poor FIG. B Poor FIG. C Good FIG D Good

PLATE V. HEAD ROOM FOR UNDERFEED STOKERS.

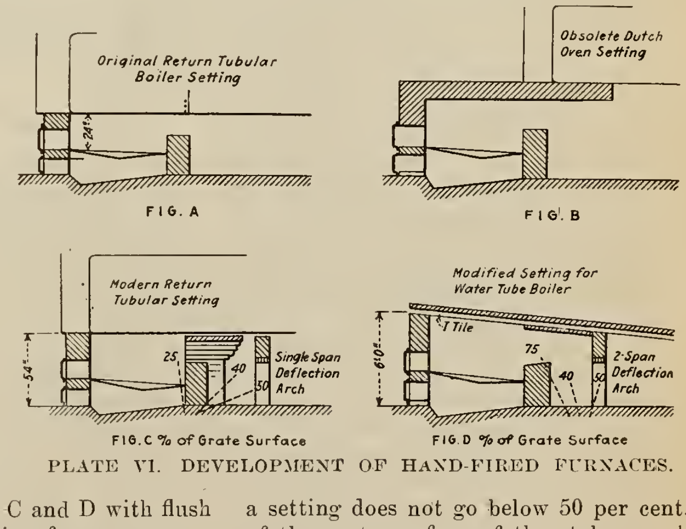

Original Return Tubular Boiler Setting
24"
Obsolete Dutch Oven Setting
Modern Return Tubular Setting
54"
25
40
50
Single Span Deflection Arch
Modified Setting for Water Tube Boiler
6'-0"
T Tile
75
40
50
2-Span Deflection Arch

FIG. A FIG. B FIG. C % of Grate Surface FIG. D % of Grate Surface

PLATE VI. DEVELOPMENT OF HAND-FIRED FURNACES.

The human element enters largely into the matter with such a setting, owing to the possibility of having considerable volatile matter pass off rapidly through carelessness. With a case of this kind it is better to set the boiler with a clearance of 10 ft. as in B, giving more opportunity for the gases to complete their combustion. One of the safest arrangements is to provide a tile-roof setting with an auxiliary bridge wall, plate II, Fig. C, breaking up the current of gases and insuring the mixture of any excess amount of volatile matter which may pass off for any cause whatever. The importance of setting this type of furnace with maximum flame travel is not always realized.

In plate III, two different types of boilers are shown with good and bad combustion of double inclined furnaces. It is a safe rule to get a full extension on this type of furnace and never resort to the flush front setting . In the case of Fig. A, plate III, the defect of short flame travel is corrected by providing a 5-ft. dog-house extension between the boiler and furnace and by raising the boiler to get the full benefit of the heating surface as shown in Fig. B. Typical Stirling settings are shown in C and D with flush front and full extension furnaces.

Front-Feed Stokers.—With the front-feed stoker the same practice should be observed as regards flame travel. A clearance of 7 ft. is not sufficient to get good results with this type of stoker and vertically baffled, water-tube boilers. A very much improved furnace can be obtained by using a head room of 10 ft. as in Fig. B, plate IV, a combination resulting very satisfactorily from every standpoint. This design also gives an opportunity for employing a vertical bridge wall, which is nearly always found to be a desirable feature wherever it can be used, as the radiating surface of the hot brick helps to keep the gases hot as they pass out of the furnace.

With a horizontal baffle it is a simple matter to combine this type of stoker successfully. Sufficient head room only is required to get the stoker under the front header. If this cannot be secured in the head room available, it does not alter the effectiveness of the design to excavate as shown in Fig. C. Sometimes piers, or deflection arches, are used with this setting to break up the current of gases. Where a free opening in such a setting does not go below 50 per cent. of the grate surface of the stoker, such construction is desirable. On a vertical boiler always get the maximum extension possible within reasonable proportions.

Underfeed Stokers.—Underfeed stokers of different types require different head room. (See Plate V.) The Jones and American types can give excellent results with a head room of 8 ft. 6 in. for a vertically baffled boiler, Fig. B, and 7 ft. for a horizontally baffled boiler. In the case of the former the effort should be to provide enough flames travel to minimize the danger of unconsumed volatile matter passing into the bank tubes. In the case of tubular boilers the above named types of stokers can be installed with 42 in. from the dead plate to the shell, Fig. C, and the combination will result in a satisfactory performance. With stokers of the Taylor type, Fig. D, a 10-ft. clearance under the front header makes an ideal combination.

Hand-Fired Settings.—One of the most common types of boiler setting encountered is the ordinary hand-fired, return-tubular setting such as is indicated in Fig. A, Plate VI. In this setting there is no attempt made to accomplish a mixture of the gases after they have passed the bridge wall. The setting, while fairly efficient commercially, is very smoky with high volatile coal, and many attempts have been made to improve it. Fig. B, plate VI, shows a full-extension, Dutch-oven setting by which it was attempted to improve the plain, hand-firing setting.

From a smoke standpoint the Dutch-oven setting is a poor combination. Contrary to stoker practice, where the fuel is introduced slowly and in small quantities, there is a considerable quantity of coal thrown on the fire at once. The strong radiation from the brick work above the fire has the effect of distilling the gases so rapidly that puffs of dense smoke will be made after firing in spite of every effort to prevent them. Fig. C, plate VI, shows how to correct this defect by baring the shell to the direct radiation of the fire. This increases the steaming capacity and provides a high temperature zone back of the bridge wall where the gases must mix positively against the deflection arch, which breaks up the stratification and so promotes combustion.

It is not practicable to combine a hand-fired, coal-burning furnace with a vertically baffled, water-tube boiler, but it is a simple matter to arrange such a furnace with a horizontal baffle, carrying out the same idea as in Fig. C. The ordinary hand-fired, horizontally-baffled, water-tube boiler furnace is covered with box tile and has nearly all the defects of the Dutch-oven shown in Fig. B, as it is practically a fire-brick enclosed furnace from which the volatile gases will be distilled at a very rapid rate. Fig. D indicates how this can be overcome. The changes indicated are, first, baring the first two rows of tubes over the fire by putting T tile on the second row, thereby avoiding the radiating effect of a mass of fire brick; second, installing a two-span deflection arch to break up the current of gases, as in the case of the return tubular boiler.

In both of these furnaces a few simple proportions should be observed to insure satisfactory results. There should be from 20 to 25 per cent. of the grate surface in free opening above the bridge wall. The free opening from the back of the bridge wall to the deflection arch should not be less than 40 per cent. of the grate surface, while the free opening under the deflection arch should be 50 per cent. of the grate surface. Hand-fired furnaces for high pressure work should be fitted with four air-syphon steam jets, spaced across the furnace above the fire doors, to be used when necessary.

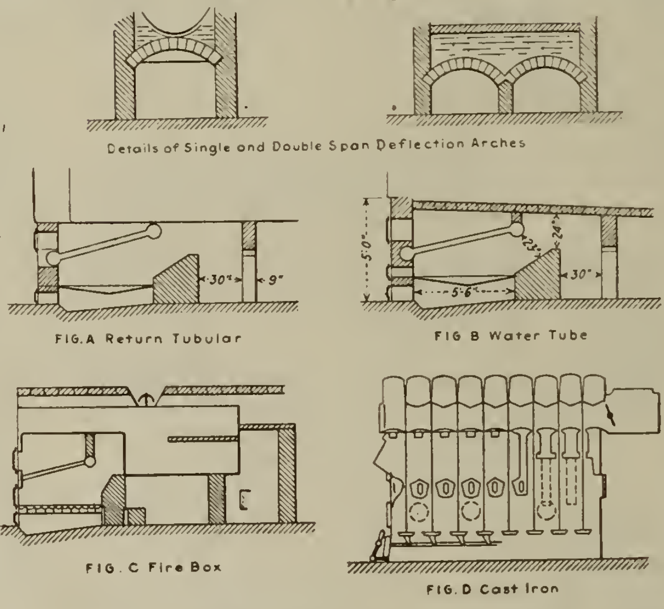

Details of Single and Double Span Deflection Arches

FIG. A Return Tubular

FIG B Water Tube

FIG. C Fire Box

FIG. D Cast Iron

PLATE VII. TYPES OF DOWN DRAFT EQUIPMENT FOR HEATING LOADS.

Low Pressure Heating Plants

The low pressure heating plant presents a problem that in some respects is more difficult than any encountered in high pressure work. The plants are not ordinarily large enough to justify stokers, and, even if such were the case, the character of the attendance is not such as would do justice to the equipment. The temperatures are lower and no steam is available for steam jets or for power to drive apparatus. With such conditions as these to meet, it has been found that the down draft principle works out very well.

A little study will show why this is so. The danger of making smoke on a down draft furnace comes from getting green coal on the lower grate, so the longer the fire can remain undisturbed the less chance of making smoke. The rate of combustion on heating loads is low, and allows for long periods during which the fires are not disturbed and no smoke is made. During these undisturbed periods there is accumulating on the water grate a thick bed of coked coal, which, when sliced down to the lower grate, does not make smoke because of the volatile matter has all been distilled off. After slicing, the fire can be heavily charged with fresh coal, without disturbing the fuel bed and consequently without causing smoke. It is then in shape for another long undisturbed period.

Another advantage of the down draft principle on heating loads comes from the fact that although the rate of combustion may be at times extremely low, yet, the water element directly in the fire furnishes a proportionate amount of steam no matter how low the combustion; so the system is more responsive than would be possible with a plain grate boiler.

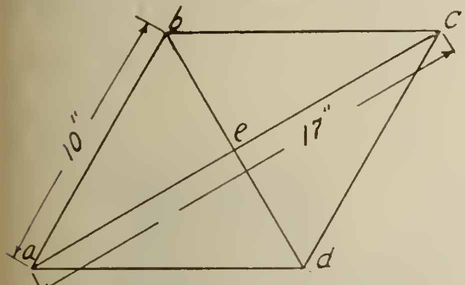
The down draft principle can be applied to return tubular or water tube boiler in the larger units. In these units it is advisable to spring an arch in the path of the gas, as shown in Figs. A and B, plate VII. As the rate of combustion on these large units at times approximates power conditions, it is desirable to guard against any excessive amount of volatile matter, which might pass over during these periods, by breaking up the current of gases and giving them an opportunity to burn.

For small units there has been developed in the past few years a number of types of self-contained, steel and cast iron boilers embodying the down draft principle. In the former type the water element consists of water tubes or pipes extended into headers in the ordinary manner and located in the fire box of a locomotive-type boiler. In the cast-iron, down draft type the water element is cast integrally with each section, forming the upper grate, the shape of the elements being such as to facilitate the slicing of coked coal down to the lower grate without disturbing the main body of fuel before the volatile matter has been distilled from it.

In conclusion attention is called to the necessity of being in possession of all the facts before attempting to work out any given smoke problem. There are so many variables such as head room, floor space, character of attendants, fuel, etc., to be taken into consideration that each job requires careful study before any recommendation can be made.

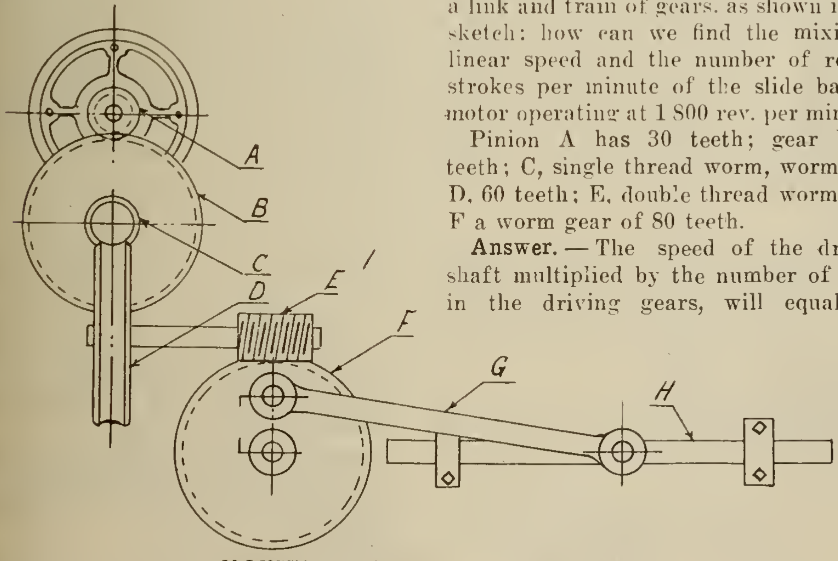
Question and Answer Series

Question—A square 10 inches on a side, is forced into a parallelogram, the long diagonal of which measures 17 inches; what is the area of the parallelogram, and the percentage of reduction?



SQUARE AND PARALLELOGRAM QUESTION.

Answer—If the length of the long diagonal, a c equals 17 inches the length of the short diagonal or line, b d, can be found from the equation b e= $\sqrt{}[(b\ c)^2—(c\ e)^2] = (10^2—8.5)^2)=$ 5.267 inches. Then as the several triangles are of similar shape and size, the area will equal the length of one of the diagonals multiplied by one-half the length of the other, or 17 × 5.267=89.539 sq. inches. The percentage of reduction from the original area of the square would be 100—89.54 = 10.46 or approximately 10½ per cent.



ILLUSTRATING SPEED OF SLIDE BAR.

Question. — When installing a motor to drive a line of shafting, would it be better to drive from the end or the middle of its length?

Answer.—Under general conditions it is advisable to have the main driving pulley placed upon the shaft as near the centre of its length as possible so as to move evenly distribute the strain throughout the shaft. When the drive is from one end the torsion on the shaft is sometimes very great, where a heavy load is carried. However local conditions must be carefully considered, as it is sometimes impossible to follow a hard and fast rule, but in all cases better results are obtained if the heavy loads are kept as near the source of power as possible.

* * *

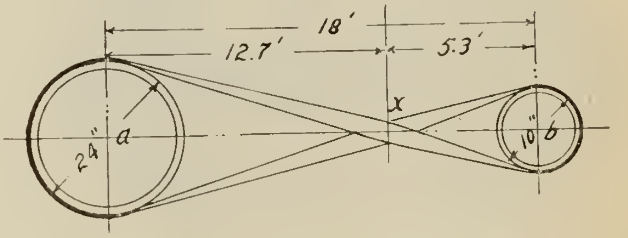
Question.—A motor operates a horizontal slide bar, through a link and train of gears, as shown in the sketch: how can we find the miximum linear speed and the number of return strokes per minute of the slide bar H, motor operating at 1 800 rev. per minute?

Pinion A has 30 teeth; gear B 80 teeth; C, single thread worm, worm gear D, 60 teeth; E, double thread worm, and F a worm gear of 80 teeth.

Answer. — The speed of the driving shaft multiplied by the number of teeth in the driving gears, will equal the speed of the driven shaft multiplied by the number of teeth in the driven gears; thus, if X equals the speed of the gear F, then 1800 × 30 × 1 × 2 =X × 80 ×60×80 or $X=\dfrac{1800\times30\times1\times2}{80\times60\times80}=\dfrac{9}{32}$ rev. per minute, or 1 revolution in 3 5-9 minutes.

The maximum speed of bar H, will be when link G is in the position shown. With the mechanism in this position the speed of bar will approximate $\dfrac{9}{32}\times\dfrac{12\times3.1416}{12}=$ .8836 ft. per minute.

Number of return strokes per minute are equal to rev. of gear F, or 9-32 of a revolution per minute.



POINT OF INTERSECTION OF CROSSED BELTS.

Question.—How can we determine the point of cross on crossed belts when the pulleys are of different sizes?

Answer.—The crossing point X will always lie nearer to the smaller pulley. The distance x b. will be to the center distance a b, as the diameter of the small pulley is to the sum of the pulley diameters. For example, a pulley 24 inches in diameter is to be connected by a crossed belt to a 10-inch pulley, shafts being 18 feet apart; where will the point x fall?

(x b) : (a b) : : d : D + d or

(x b) : 18 : : 10 : 24 + 10 then

$(x\ b)=\dfrac{18\times10}{24+10}=\dfrac{180}{34}=5.3$ ft.

* * *

Question—Why are some alternating-current generators rated in kilovolt-amperes instead of kilowatts, and what is the difference between the two terms?

Answer—The kilovolt-ampere rating expresses the electrical output, while the kilowatt rating expresses mechanical or actual energy output. Kilovolt-ampere is the measure of the capacity of an alternating current generator just as horse power or kilowatt is the measure of the capacity of the engine or turbine driving the generator. Dealing with the capacity of the generator itself, it should be rated in kilovolt-amperes. Again when dealing with the prime mover and the actual energy output of the complete unit the rating should be in kilowatts. Under a certain ideal condition, the kilovolt-ampere output becomes identical with the kilowatt output. The conditions of operation met with in practice are, however, seldom ideal. They are usually so adverse, as a matter of fact, that the energy output is less than the electrical by many per cent. A generator operating with an output of only 100 k.w. in actual energy may be delivering current at a potential that would produce 120, 150 or 200 k.w. if the conditions of load were more favorable. In fact, the internal work in the generator itself would be less if delivering 120, 150 or 200 k.w. under the better conditions. The relation or ratio of kilowatts to kilovolt-amperes is expressed by the term the power-factor.

* * *

Question—For a small plant, which is the better system of ice-making, the compression or the absorption, and why?

Answer—In small plants, the compression system is preferable. It is less complicated and requires less water.

* * *

Question—Why is it that the load curve of an exciter does not more nearly parallel the load curve of the generator it is exciting?

Answer—The exciter load curve does not parallel that of the generator because the generator field requires considerable excitation at no load to maintain rated voltage at the generator terminals. Again, at a given load, greater excitation is required to maintain normal voltage when the power-factor is lower than is needed with unity power-factor, for the reason that the lagging armature current tends to demagnetize the fields.

* * *

Question—Should a valve in its travel open a full port to live steam?

Answer—No, because the ports are designed, so as to allow of a free escape of exhaust steam, and if a full port be given, or be necessary for live steam, then for exhaust, the port is not large enough.

* * *

Question—Why is it necessary to have a larger area of port for the exhaust, as compared with the live steam?

Answer—Because the live steam having done its work in the cylinder has fallen in pressure, and become naturally of greater volume, and requires a larger space or area for escape.

* * *

Question—What is the highest voltage at which alternating-current motors have been operated with satisfactory results?

Answer—The highest voltage used with success on synchronous alternating-current motors is 13,200 volts, and on induction alternating-current motors, 6,600 volts.

* * *

Question—Why is it that the starting torque of an alternating-current series motor is not as good as that of the direct-current series motor?

Answer—The starting torque of a series alternating-current motor is less than that of a similar direct-current motor, principally because it becomes zero twice each cycle, instead of acting continuously.

* * *

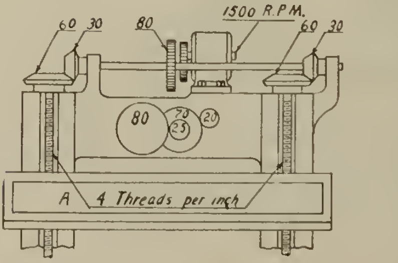
Question—Is exhaust steam operation practicable on a system designed for live steam operation, and vice versa?

Answer—In exhaust steam operation, it is necessary to have pipes of larger size because low pressure is carried. With live steam, the pressure can be carried high, and, therefore, smaller pipes may be used. There are two difficulties which may be encountered in trying to operate a heating system with exhaust steam which has been designed for live steam. In the first place there are many heating systems designed to operate on live steam which have not sufficient radiating surface to properly warm the building in extremely cold weather without raising the pressure from 10 to 15 lbs. or more. This cannot ordinarily be done when exhaust steam is used. Again, there are many heating systems poorly laid out or in bad repair which will not drain back the returns from all parts, unless a rather high pressure is carried. This second fault can usually, however, be corrected by installing a vacuum pump. There should be no trouble in operating with live steam a system designed for the use of exhaust steam.

* * *

Question.—With the motor running at 1,500 revolutions per minute, and the other dimensions as shown in the sketch, what time would it take to raise the cross bar A 3 feet?

Answer.—The speed of the driving shaft multiplied by the number of teeth in all the driving gears will equal the speed of the elevating screws multiplied by the number of teeth in all the driven gears; or, taking x as the speed of the housing screws, we have $1,500\times20\times25\times30 = x\times70\times80\times60$, or $x = \dfrac{1,500\times20\times25\times30}{70\times80\times60} = 67$ r.p.m. Therefore, the time required in raising A 3 feet would be $\dfrac{4\times12\times3}{67} = 2.15$ minutes.



* * *

Question.—Steam is expanded to 10 pounds absolute pressure, and it is desired to have the feed water at 130 degrees, the temperature of the injection water being 86 degrees, how many pounds of injection water, per pound of steam condensed, will be required?

Answer.—The total heat of steam at 10 pounds absolute is 1172.3 thermal units, therefore the ratio required is $\dfrac{1172-130}{130-86}$, or 23.7 to 1. The common allowance for engines with surface condensers is 24 to 30 times the weight of steam condensed, and for engines with jet condensers, from one-third to one-half the cylinder capacity.

* * *

Question.—A hydraulic elevator is operated by a piston 16 inches in diameter and 240 pounds per square inch of water pressure. There are two moving sheaves and two stationary sheaves, a single cable going to the car. What load can be lifted by the elevator?

Answer.—As the piston works against five cables, while the elevator is taken by one, the leverage ratio of the piston to elevator is 1 to 5. Area of piston $= 16\times16\times.7854 = 201.06$ sq. ins. Total pressure on piston is $201.06\times240 = 48,254.4$ pounds. The load that can be lifted by the elevator, therefore, is $\dfrac{48,254.4}{5} = 9650.9$ pounds, or about 4½ tons.

* * *

Question.—The crank arm of an engine is 13 inches long and the length of the connecting rod is 65 inches. If the engine be running under, and the pressure on the piston be 2¼ tons, what will be the greatest thrust of the crosshead against the upper guide?

Answer.—Size of driven wheel on ton in this case may be resolved into a vertical component and a horizontal component.

The vertical component is represented by 13 and the component in line with the connecting rod is 65. The horizontal component is $\sqrt{(65^2-13^2)} = 63.6$. This horizontal component actually is 2¼ tons, therefore the vertical component which acts against the guide is

$$4250 : 63.6 :: x : 13$$

$$x = \frac{4250\times13}{63.6} = 868,707 \text{ lbs.}$$

Steam Power Plant Auxiliaries

BOILER FEED PUMPS.—IV.

THE pump illustrated in Fig. 21 is of the simplex type with single automatic steam actuated, distributing valve, which dispenses with external valve gear levers, etc.

"Goldie & McCulloch" Simplex Pump

This design of pump is built by the Goldie and McCulloch Co., Ltd., Galt, Ont., who supply it in four sizes from 5 in. x 3 in. x 3½ in. with a capacity of 470 to 950 gallons per hour to 8 in. x 5 in. x 10 in. with capacity of 3.000 to 6,000 gallons per hour. As can be observed in Fig. 21, the base is cast with enclosed compartment which forms suction chamber, to either side of which the suction pipe may be attached. The passage from this chamber into the water end is clearly shown in Fig. 22 along with the more important constructional features.

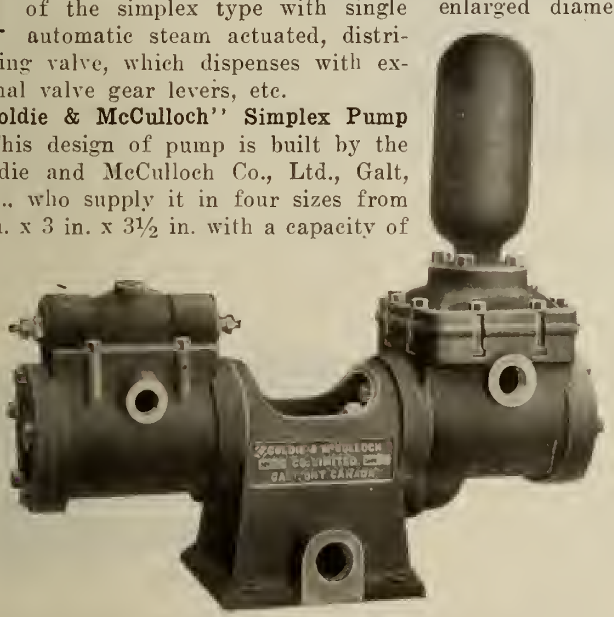


FIG 21. "GOLDIE & McCULLOCH" SIMPLEX PISTON TYPE BOILER FEED PUMP.

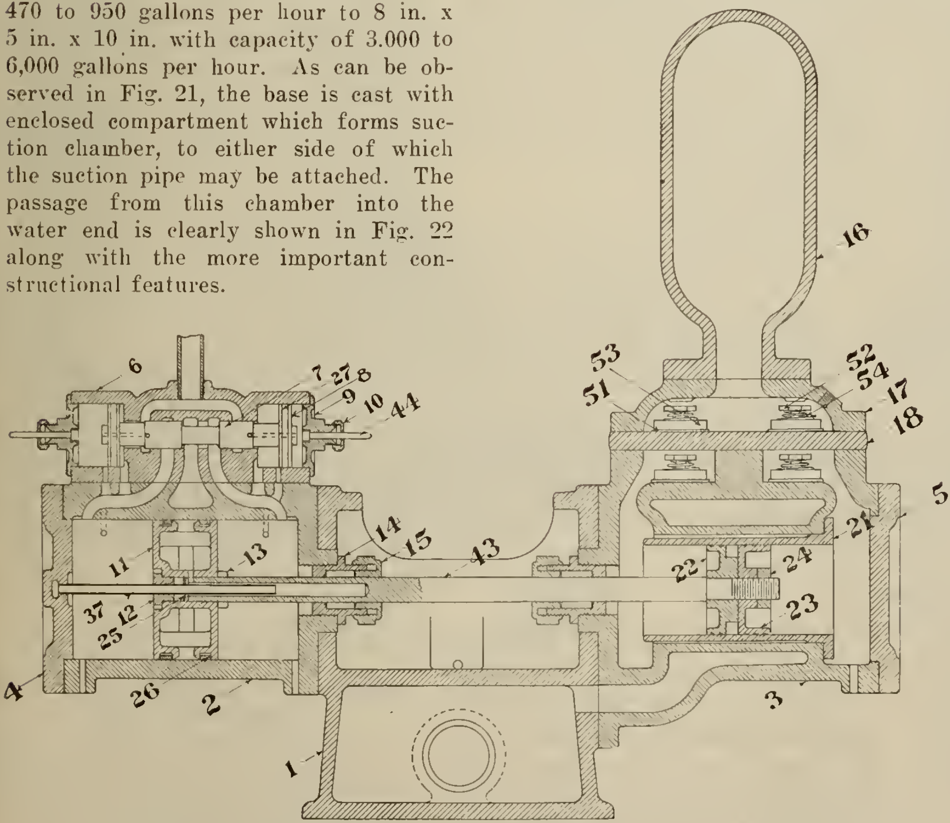


FIG. 22. SECTIONAL VIEW OF "GOLDIE & McCULLOCH" SIMPLEX PISTON TYPE BOILER FEED PUMP.

The distributing valve for the steam end is of the straight piston type, the enlarged diameter in the centre controlling the admission and exhaust at the left and right hand respectively, the main piston as shown travelling from left to right. When the main piston reaches the end of its stroke, live steam, which is supplied to its interior by a tubular triprod 37, is by-passed to the outside of steam valve end 8, throwing the valve over to the opposite position and reversing the admission and exhaust of steam in the cylinder.

The water end as shown is fitted with a removable brass liner, the valve seats, rod, stuffing box glands, etc., being also brass, while the one-piece pistin rod is of Tobin bronze. The design of this pump does not involve the necessity of expensive foundations while the cylinder construction admits of easy removal for inspection on repairs.

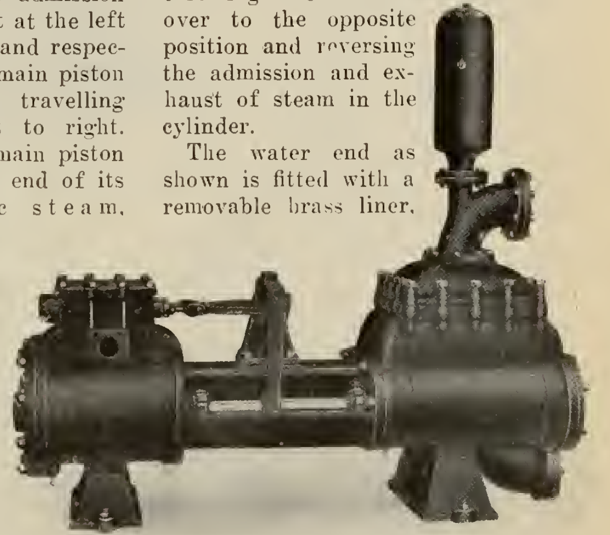


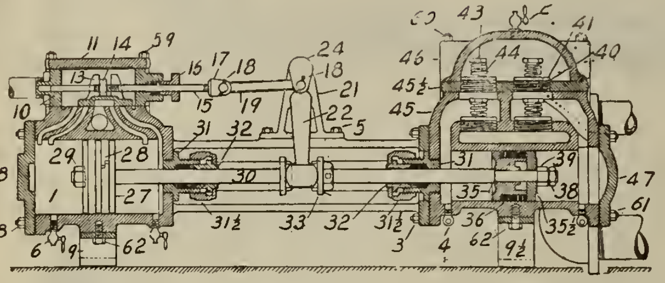
FIG. 23. "SMART-TURNER" DUPLEX PACKED PISTON BOILER FEED PUMP.

"Smart-Turner" Duplex Pumps

The pump illustrated in Fig. 23 is a 12 in. x 8½ in. x 12 in. duplex, packed piston pump built by the Smart-Turner Machine, Co., Hamilton, Ont., and is typical of the general design followed in all sizes of this type. Twenty-four sizes of this type are built capable of feeding boiler horse-power from 30 to 4,100. Packed water pistons and screwed-in brass valve seats are employed throughout the various sizes, rubber or brass valves being fitted according to the service.

Constructional features are clearly indicated in Fig. 24 (upper). Separate views of the principal parts are given in the lower portion of this illustration which also shows the discharge elbow and air chamber which is fitted to all sizes larger than 7½ in. x 5 in. x 10 in.

Duplex, outside, end-packed plunger pumps as built by this firm are shown in Fig. 25, the particular size illustrated being 12 in. x 7 in. x 12 in. The complete range of sizes built in this type extend from 4½ in. x 2 in. x 4 in. up to 18½ in. x 11½ in. x 15 in. Pot valves are used on all sizes, each valve, or in the larger sizes each nest of valves is in its own pot, by removing the cover of which the valves are completely accessible for inspection or grinding.



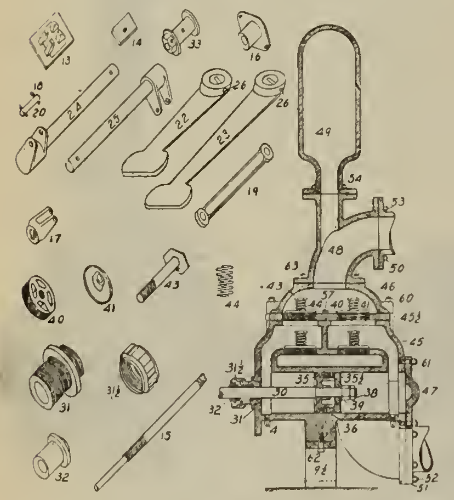


FIG. 24. SECTIONAL DETAILS AND PARTS OF TYPICAL "SMART-TURNER" PUMP.

This type of pump is well suited for high pressure boiler feeding up to 300 lbs. per sq. in., any leakage past the plunger being immediately observed, so that the packing is given more constant attention and the resulting efficiency of the pump maintained at a higher level. Brass valves of the wing pattern are employed, the wings being set at an angle so that in rising and falling the valves make a partial turn causing a self grinding effect which insures even wear and constant tightness of the valve faces. The arrangement of valves and plungers is shown in section in Fig. 25. The following list of part numbers corresponds to the numbers on Fig. 24.

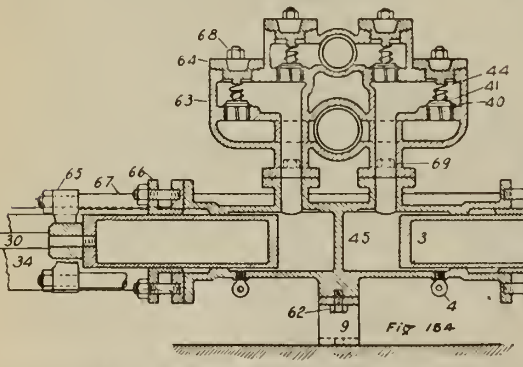


FIG. 25 WATER END OF "SMART-TURNER," OUTSIDE END PACKED PLUNGER PUMP

1. Steam cylinder.
2. Water cylinder air cock.
3. Stud, stretcher to water cylinder.
4. Water cylinder drain plug.
5. Cap screw, pedestal to stretcher.
6. Drip cock, steam cylinder.
8. Steam cylinder head.
9. Steam cylinder foot.
9½. Water cylinder foot.
10. Steam chest.
11. Steam chest cover.
13. Slide valve.
14. Valve rod nut.
15. Valve rod.
16. Valve rod stuffing-box gland.
17. Valve rod jaw.
18. Cotter pin.
19. Link.
20. Motion pins.
21. Pedestal.
22. Short lever.
23. Long lever.
24. Upper rock shaft.
25. Lower rock shaft.
26. Taper pins for rock shafts.
27. Steam piston.
28. Steam piston rings.
29. Steam piston rod nut, steel.
30. Piston rod.
31. Piston rod stuffing box.
31½. Piston rod stuffing box nut.
32. Piston rod gland.
33. Spool.
34. Stretcher.
35. Packed water piston body.
35½. Packed water piston follower.
36. Water piston packing.
38. Brass piston rod lock nut.
39. Brass piston rod nut.
40. Valve seat.
41. Rubber or brass valve.
42. Valve backing (for rubber valve only).
43. Valve bolt.
44. Valve spring.
45. Water cylinder.
45½. Valve deck.
46. Valve deck cover.
47. Water cylinder head.
48. Discharge elbow.
49. Air chamber.
50. Discharge flange.
51. Suction flange.
52. Suction flange nuts.
53. Discharge flange bolts.
54. Air chamber bolts.
58. Steam cylinder head stud.
59. Steam chest stud.
60. Valve deck cover.
61. Water cylinder head studs.
62. Cap screw, foot to cylinder.
63. Discharge elbow studs.

"Fairbanks-Morse" Boiler-Feed Pumps

The general design of these pumps is shown in section Fig. 26, while the external appearance of the medium sizes is in Fig. 27. They are built by the Canadian Fairbanks-Morse Co., Toronto, and are suited for boiler pressures up to 150 lbs. per sq. in. above which the outside packed plunger pump is adopted. They are of the duplex pattern, the steam mechanism of which is familiar to nearly all pump users. Flat steam slide valves are used for controlling the distribution of steam to the cylinder, while the water end is so designed that the water piston is submerged, by reason of all the water valves being located above the water piston, which works in a renewable liner. Spring controlled disc valves are used, the material being either brass, hard rubber, or soft rubber according to the nature of the service.

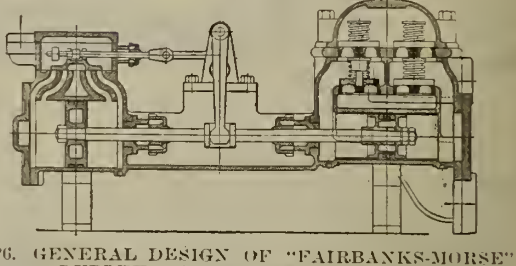


FIG. 26. GENERAL DESIGN OF "FAIRBANKS-MORSE" DUPLEX BOILER FEED PUMP.

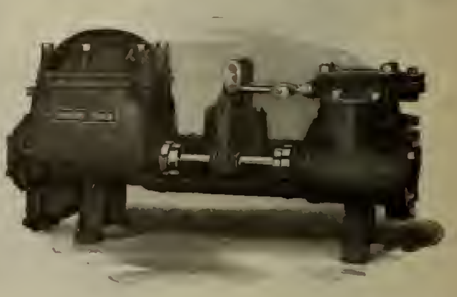


FIG. 27—EXTERIOR VIEW OF MEDIUM SIZE "FAIRBANKS-MORSE" PUMP

Duplex ram pattern pumps are built for discharge pressures not exceeding 175 lbs. per sq. in. with capacities suited for boiler horse powers from 150 to 1,700. The design is such that all the desirable advantages of this type of pump are obtained, the element of slippage being reduced to a minimum and the volumetric efficiency correspondingly increased, see sectional view Fig. 28.

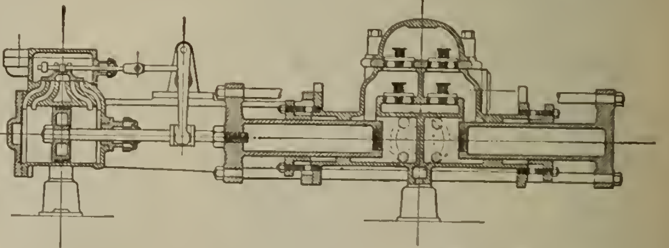


FIG. 28 SECTIONAL VIEW OF "FAIRBANKS-MORSE" OUTSIDE END PACKED PLUNGER PUMP

"Terry" Turbine-Driven Centrifugal Boiler-Feed Pumps

The subject of boiler-feed pumps would be incompletely covered were reference not made to centrifugal pumps for boiler-feed purposes. As is well known, centrifugal pumps are readily adaptable to widely different conditions of up one stage on the other, the ability of the pump to operate against high pressure is greatly increased so that as now built by the Terry Steam Turbine Co., of Hartford, Conn., pumps of this type direct connected to steam turbines, have capacities from 100 gal. per min. up with discharge pressures up to 300 lb. per sq. in.

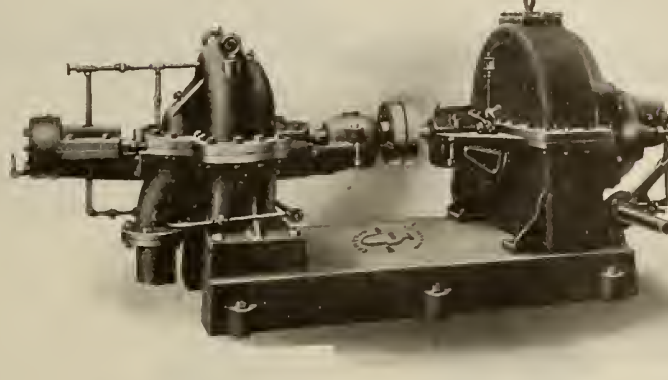


FIG. 29. TWO-STAGE CENTRIFUGAL BOILER-FEED PUMP DIRECT CONNECTED TO "TERRY" STEAM TURBINE.

A two-stage centrifugal turbine set by these makers is shown in Fig. 29, the capacity being 450 gal. per min., against a pressure of 170 lb. per sq. in. A sectional view of the centrifugal pump is shown in Fig. 30. After entering the suction branch A, the water passes through the annular suction passage B into the revolving impeller C, leaving it at the point D where it passes through stationary diffusion vanes and reversed by the outer casing at the point E and is directed toward the centre again where it enters the second stage impeller through the suction passage F being afterward discharged in the usual way through a tangential passage the flange on which is shown dotted behind the casing. The impeller shaft is supported on two bearings the one on the right being of the ring-oiling type, while the bearing on the left is arranged to take the thrust due to the pull of the two suction passages B and F, which draws the shaft toward the thrust bearing. This thrust bearing is water cooled by a by-pass pipe from the first stage casing into the suction pipe A, the packing glands being lubricated by a similar arrangement.

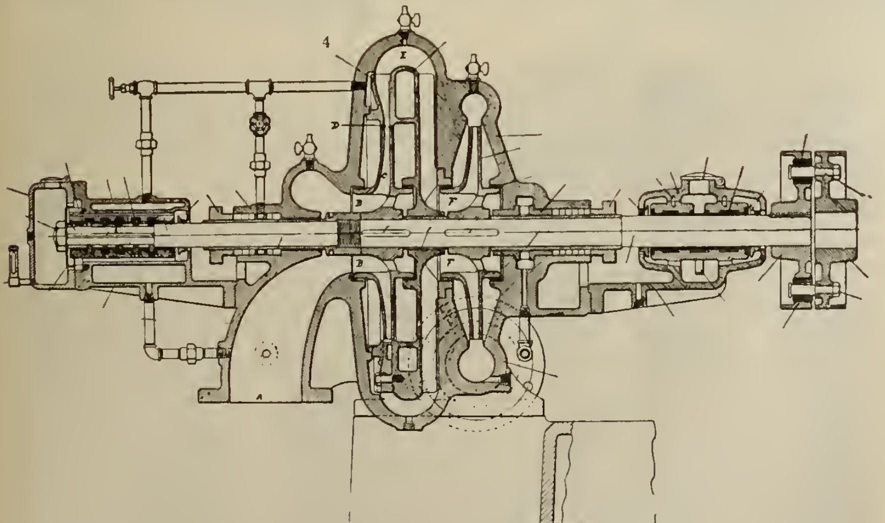


FIG. 30. SECTIONAL VIEW OF TWO-STAGE CENTRIFUGAL BOILER FEED PUMP.

Owing to the fact that the steam is used expansively, a turbine driven feed pump shows better steam economy than the ordinary direct driven reciprocating type. Apart from the pump itself, however, the absence of vibration is a desirable feature, not only in the machine, but in the feed water pipe line. The steady continuous flow of water induces a marked absence of vibration in the pipes while the almost entire absence of tear and wear makes itself evident in reduced packing consumption, etc.

BOILER INSPECTION AT MONTREAL

FROM year to year Montreal's immunity from boiler explosions has reflected the highest credit on the efficiency of the inspections carried on by Boiler Inspector Champagne, whose annual report has just been issued. It repeats what has become the accustomed thing in all these reports from the Boiler Inspector's Department, that for thirty-seven years no boiler accidents have occurred in Montreal involving the loss of life. Reference is made to recent provincial legislation which is regarded unfavorably by Mr. Champagne, and which has been the subject of protest by a large number of boiler engineers and firemen. Although the smoke nuisance is an unsolved problem, Mr. Champagne finds an improvement to record. Much has been accomplished, he says, and further success is anticipated. The report says:

The report also contains a letter sent to the Board of Control six years ago, at the inception of the new waterworks project, in which the point was discussed of the greater suitability for boiler purposes of the water from the Ottawa River as compared with that from the St. Lawrence, due to the fact of the latter being harder, and, therefore, more liable to form incrustations or scale on boiler heating surfaces. Since the date mentioned, the city's water supply has been changed, so that the main supply now comes from the centre of the St. Lawrence. The following is a summary of the work done during the year 1914:

Inspection of steam boilers—Visits of inspection, 2,760; internal and external examinations, 1,603; hydraulic tests, 1,526; hydrostatic tests, 127; imperfect boilers, 210; boilers condemned, 5; new and second-hand boilers erected, 91; new boilers (included in this number), 80; notices of inspection issued and received, 603.

Engineers and firemen—Certificates and licenses and renewals, 2,100; failed to pass examination, 359.

Suppression of smoke—Visits made in connection with new devices for abatement of smoke, 342; new devices installed during the year, 14; notices issued, 57; cases brought before the Recorder's Court and resulting in convictions, 3.

◆

Illness Cost to Industry.—As a result of unnecessary sickness and accidents the 33,000,000 industrial workers in the United States lose about 284,000,000 working days each year as a result of sickness alone, according to Dr. Donald B. Armstrong, director of the Department of Social Welfare of the New York Association for Improving the Condition of the Poor. He figures the financial loss, including wages, loss to industry and the medical cost at nearly $500,000,000, and yet at least one-half of the sickness, he says, was from strictly preventable causes.

◆

Boiler Manufacturers' Convention.—The twenty-eighth annual convention of the American Boiler Manufacturers' Association will be held at the Hollenden Hotel, Cleveland, Ohio, June 19 and 20. An interesting programme is being prepared, including a discussion on uniform cost system and reports of progress toward the adoption of the A. S. M. E. boiler code by various States. The executive committee expects to arrange for a visit to one or two Cleveland manufacturing plants of interest to boiler builders during the convention. W. C. Connelly, of the D. Connelly Boiler Works Co., Cleveland, Ohio, is president of the Association.

Progress in New Equipment

STEAM SOOT BLOWER ARRANGEMENT

A SYSTEM for removing soot and fine ashes from the heating surfaces of vertically baffled water-tube boilers, and based essentially upon projecting powerful oscillating steam jets into, through and laterally across the spaces between the horizontal rows of tubes in planes parallel to the pitch of the tubes, is now being offered by the Bayer Steam Soot Blower Co., of St. Louis, Mo.

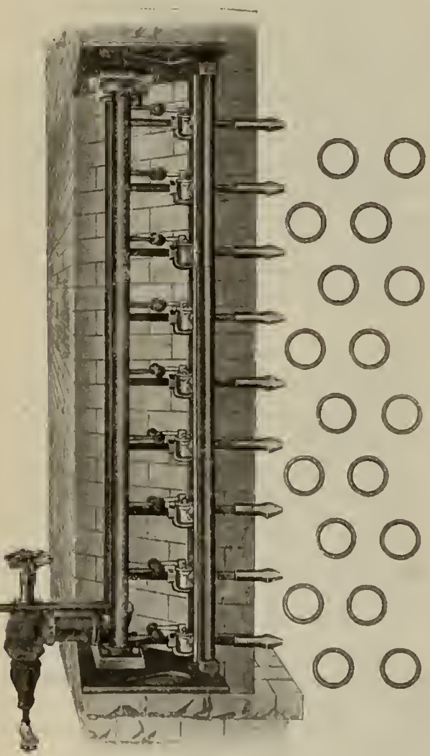


FIG. 1. VIEW OF BLOWER UNIT.

The soot blower has been so designed that the parts can be placed without changing or cutting brick work and walls, the original cleaning openings and internal wall angles in the side of the boiler being ample to permit a wide swing of the nozzle heads. The nozzles are divided into groups or individually controlled blowing units, Fig. 1, each of which serves a gas pass or compartment, and is fitted into the cleaning pockets originally provided along the side wall for hand cleaning. The individual units receive their steam from a supply line passing below the blowing units, and having a drain at the lowest point to permit the removal of any possible condensation just before each blowing operation.

The action of the jets through their direct force and expansion of the steam is to create intense momentary drafts that loosen the objectionable particles and push and pull them out of the gas passages into the stack. The method of imparting oscillation to the nozzles will be understood from Fig. 2. Each blowing unit has a riser connected to the steam line, and controlled by its own valve. Short branches extending inward from the riser connect the riser with swing joints, the moving members of which are connected through nipples to the three-way nozzle heads within the furnace wall. A vertical rocking shaft located at the side of the riser connects with the moving members of the swing joints through sets of links and levers. By rocking the shaft alternately from right to left, the entire series of nozzle heads is swung back and forth, the steam being delivered in three separate powerful jets from each nozzle which agitate and remove the soot and ash deposit.

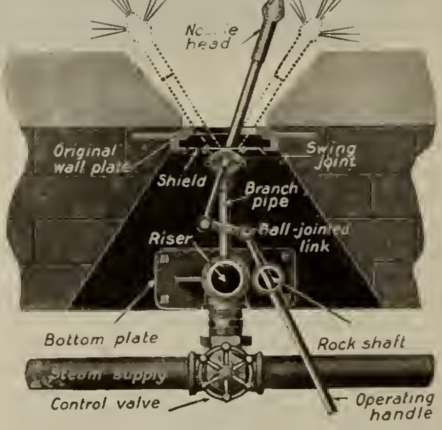
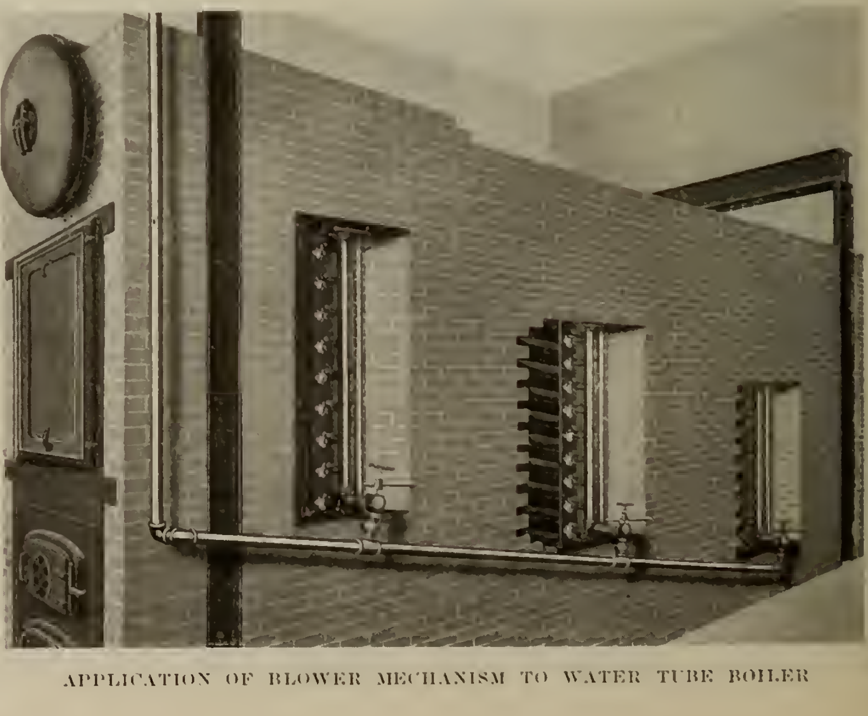
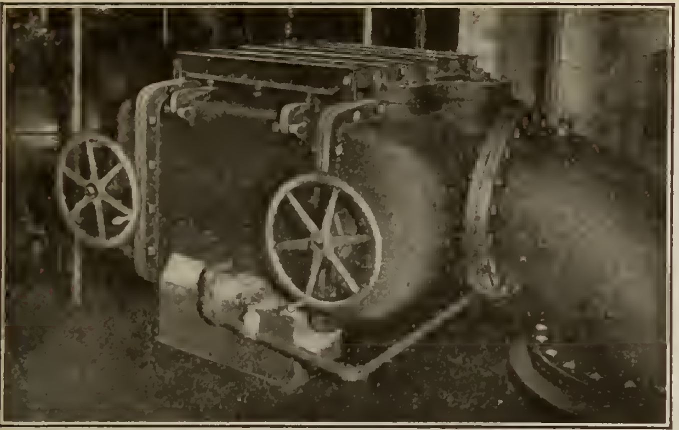


FIG. 2. MECHANISM FOR OSCILLATING BLOWER NOZZLES.

The type of swing joint used, in addition to permitting easy installation, inspection and overhauling, may be brought squarely up against the cover shield which closes the cleaning pocket, and is tilted to the same pitch as the tubes. This permits the steam to sweep at all points within the plane spaces between the tubes, which is essential to thorough cleaning. The swing joints are bolted to a metal cover shield which fits against and is clamped to the two strips on the wall plate, the cleaning pocket being thus permanently air-tight. The unit is located when the shield is



APPLICATION OF BLOWER MECHANISM TO WATER TUBE BOILER



24" Twin Strainer in condenser circulating water line.

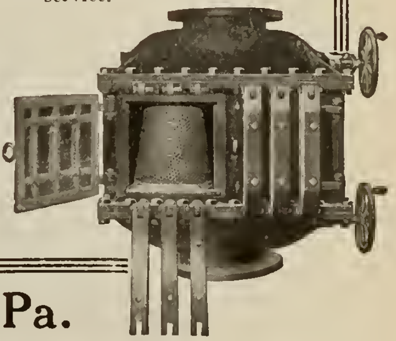
Twin Strainers

Insure Continuous Service

The Twin Strainer stands on guard twenty-four hours a day, and removes from the water all such foreign matter as dead leaves and grass, sticks, fish, etc., that would clog up and injure the pump and condenser.

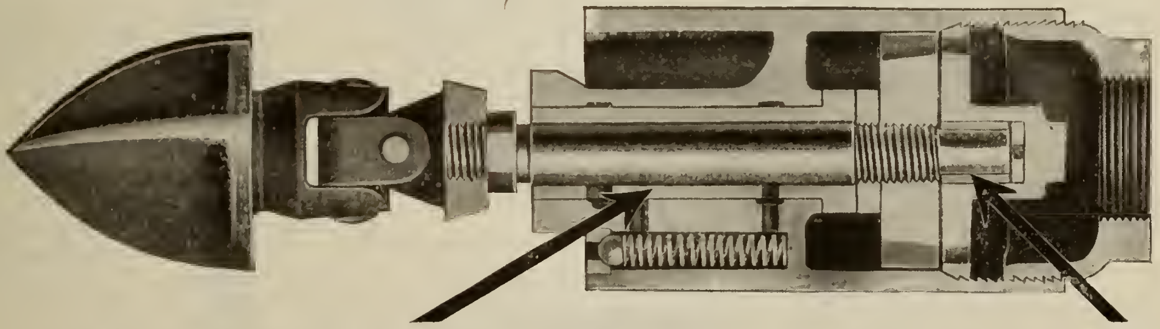
The Twin Strainer is the only direct-flow strainer that can't be clogged. When the solids accumulate in one of the two straining baskets, a clean one is put in service by simply operating two valves. The dirty basket can then be lifted out, carried to a convenient place, cleaned, and replaced in the Strainer—all this without interrupting the supply of water for an instant.

Twin Strainers are made in sizes ranging from 1 to 48 ins. with perforations in the straining baskets to suit your service.



Twin users are the best boosters we have. Send for a copy of Bulletin "A" and join the army.

Elliott Company, 6902 Susquehanna St., **Pittsburgh, Pa.**



BUSHED BEARINGS ARE BEST

IN A TUBE CLEANER

Because the weight of the rotating parts is so small that the friction load on any type of bearing in good condition is negligible compared with the load of removing scale.

BUT—there is a shock load due to vibration. And you know that ball and roller bearings will not stand up under shock. And it is impossible to keep the grit and dust from the scale out of ball or roller bearings.

The LIBERTY CLEANER uses bushed bearings which do stand up under shock and which are practically impervious to grit. On account of wear, the friction load on ball or roller bearing Tube Cleaners increases rapidly with use. Friction load on LIBERTY bearings does not increase.

GET THE BEST—GET THE LIBERTY.

LIBERTY MANUFACTURING COMPANY 6904 Susquehanna Street
Pittsburgh, Pa.

Canadian Representatives: Williams & Wilson, Ltd., Montreal; A. R. Williams Machinery Co., Toronto and Winnipeg

If any advertisement interests you, tear it out now and place with letters to be answered.

clamped into place. Adjustment of the units in permanent position can be completed while the boiler is in service, and the rest of the installation is merely a matter of piping.

* * *

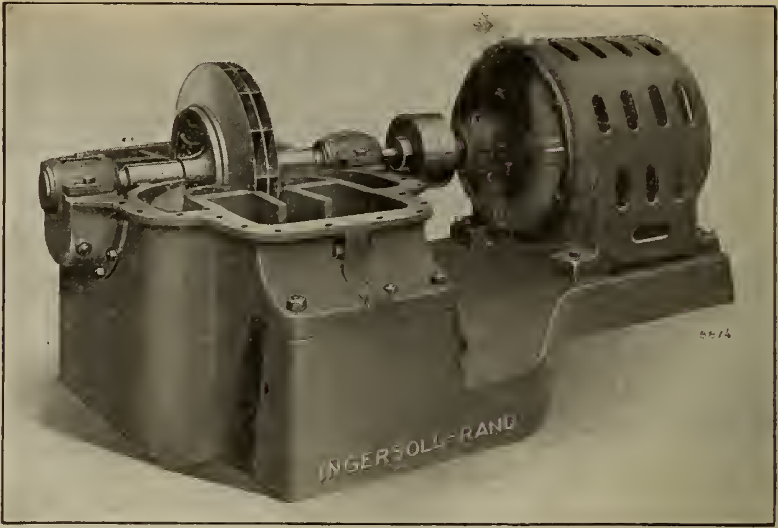
MOTOR-DRIVEN LOW PRESSURE TURBO BLOWER

THERE has been added to the line of turbo blowers and compressors manufactured by the Ingersoll-Rand Co., New York, a low pressure machine to handle volumes from 3,000 to 35,000 cubic feet per minute at from 1-2½ pounds. . It is particularly adapted to such service as foundry cupola blowing, atomizing oil for oil burners, supplying blast to heating and annealing furnaces of various kinds, blowing air for water gas generators, pneumatic conveying and ventilating.

The blowers are of the single stage, double flow type, and are furnished either electric motor, steam turbine or water wheel driven. Electric drive is generally employed for the classes of service above mentioned, the high operative speed permitting direct coupling to motor. The motor-driven machine will maintain constant pressure while delivering any volume from zero to maximum demand and proportionately varies the electrical horse-power input.

These turbo blowers embody the four bearing construction featured in all turbo machines of the company's make. The casing is horizontally split for ease in installation and subsequent inspection. The assembled casing is doweled and bolted to a heavy sub-base, which ordinarily serves for both blower and driving element. The floor space occupied is small, and the change of vibration obviates the necessity for foundation bolting.

The impeller is of the enclosed double flow type, claimed by the manufacturer to secure the highest efficiency. The wheel is machined from a solid, special steel forging. Vanes and covers are of pressed steel securely riveted, all rivet heads being driven flush and the entire assembly polished; skin friction is thereby reduced to a minimum.



MOTOR-DRIVEN LOW-PRESSURE TURBO BLOWER WITH UPPER HALF OF CASING REMOVED.

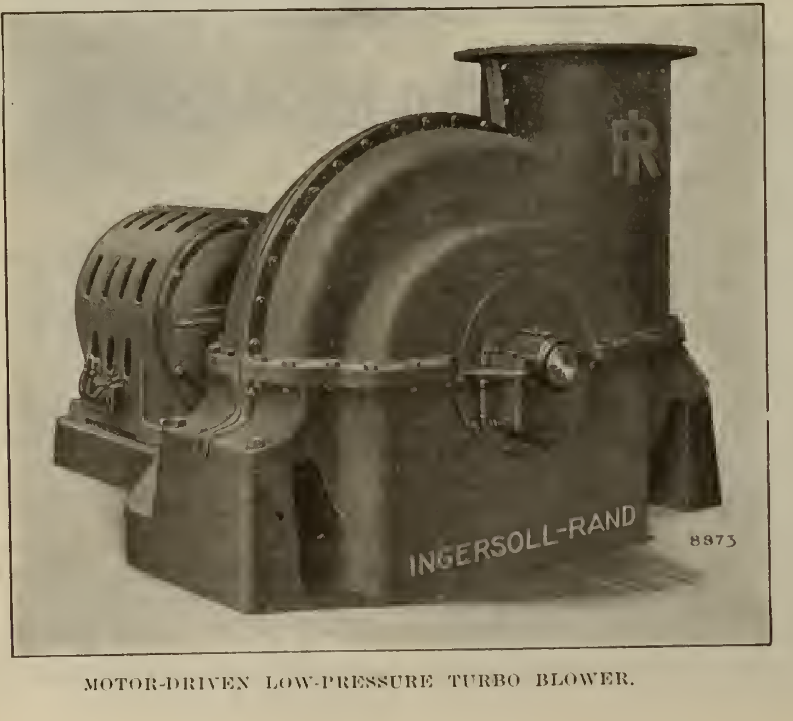
ELECTRICAL EQUIPMENT FOR NEW ZEALAND

The Department of Trade and Commerce has been informed by W. A. Beddoe, Trade Commissioner, Auckland, that the Oamaru Borough Council invites tenders up to June 23 for the following contracts:—Overhead mains; power station equipment (Pelton wheels, alternators, etc); service metres and transformers. Plans and specifications have been sent to the Department, where they may be secured on application. (Refer File No. A-1939.)

All impellers are overspeeded in a testing machine to insure correct balance, strength and eliminate vibration. They are keyed to a heat treated, forged steel shaft. Labyrinth packing is employed to prevent leakage between impeller and casing. Bearings are ring oiled and both bearings and their housings are horizontally split.

The use of flexible couplings between blower and driving unit is made standard practice. All the machines are of the closed intake type, the intake opening being at the bottom and discharge at the top. The flow of air is claimed to be absolutely uniform, thereby avoiding all pulsations, and making the units especially desirable for foundry work.

The manufacturers emphasize the fact that there are no rubbing surfaces, and point out that this precludes the necessity for adjustment to take up wear, while minimizing the cost of maintenance. It is to be noted that the only lubrication necessary is that of the bearings, all other parts working without friction. Maintenance of efficiency over long periods of time is understood to be a special feature of these turbo blowers.

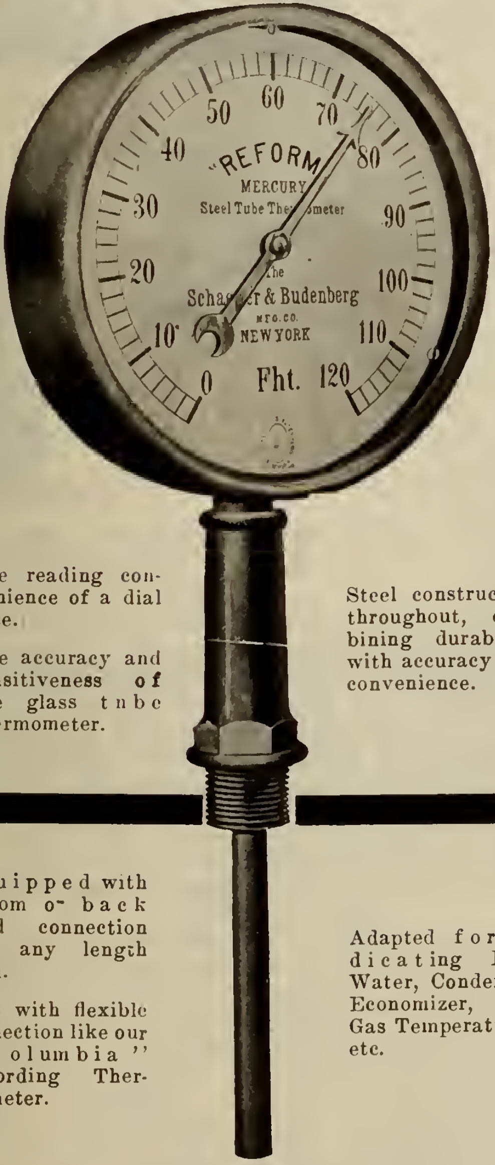


MOTOR-DRIVEN LOW-PRESSURE TURBO BLOWER.

* * *

An announcement has been made by the premier of the New South Wales Government that a bill providing for the construction of the high-level bridge connecting the city of Sydney with the harbour, at an estimated cost of $15,000,000, is in the course of preparation, and will be introduced into the Legislative Assembly at an early date. The engineer to the Public Works Department, however, states that the work of construction cannot be commenced until after the war, owing to the difficulty in obtaining the necessary materials.

"REFORM"
Mercury Actuated Dial Thermometer



The reading convenience of a dial face.

The accuracy and sensitiveness of the glass tube thermometer.

Steel construction throughout, combining durability with accuracy and convenience.

Equipped with bottom or back rigid connection and any length stem.

Also with flexible connection like our "Columbia" Recording Thermometer.

Adapted for indicating Feed Water, Condenser, Economizer, Flue Gas Temperatures, etc.

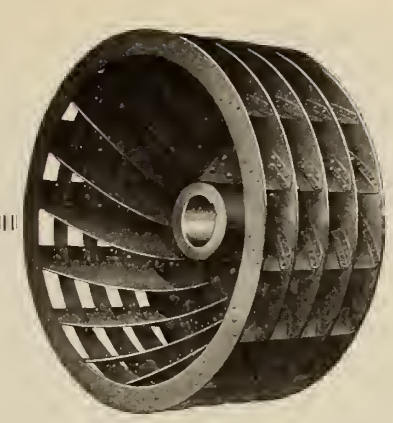
Ask for Pamphlet W-101

THE Schaeffer & Budenberg MFG. CO.

Makers of "Columbia" Recorders, "Crescent" Thermometers, S & B Gauges, Tachometers, Counters, Calorimeters, Indicators, etc.

Berry and South 5th Streets, Brooklyn, N. Y.

Also Chicago, Philadelphia, Pittsburgh.



The Latest Thing for Forced Draft

In the Port Morris Station of the New York Central Railroad the forced draft requirements are very severe.

450,000 cu. ft. of air per minute at a pressure of 6" is necessary. This is all supplied by Sturtevant Fans. Two of the supplying units are turbine-driven turbovane fan sets, each turbine driving two fans. The

Sturtevant
(REG. CAN. PAT. OFF.)

Turbovane Fan

has been especially developed for high pressure forced draft work, such as usually obtains in under-feed stoker installations.

The Turbovane may be either turbine or motor-driven, but is primarily designed to operate at speeds most economical for Sturtevant Turbines. Consequently the overall efficiency of the set is high.

The Sturtevant Turbine and Turbovane Fan set forms a combination that is absolutely unique in its field.

A few typical installations are

Interborough Rapid Transit Co., 74th St. Station, New York, 16 turbines driving 32 fans (this company sent in a duplicate order recently for 5 turbines driving 10 fans); Malden Electric Co., Malden, Mass., 1 set; New England Mfg. Co., South Wilmington, Mass., 2 geared sets; International Ry. Co., Buffalo, N.Y., 2 sets.

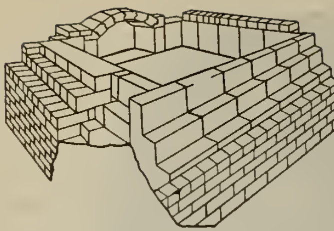
Write us for information.

B. F. Sturtevant Company of Canada, Limited

GALT, ONTARIO, CANADA

MONTREAL, TORONTO, WINNIPEG, VANCOUVER

Selling Agents for Sanford Riley Stoker Co., Limited
"THE RILEY STOKER"



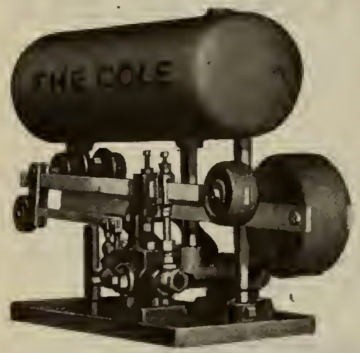
Gates Boiler Furnace

Patent Applied For

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

—*WRITE FOR PARTICULARS.*—

John W. Gates 382 St. James St.
Montreal, Que.



Promotion Is Sure

when you can show the man above you how he can pay more dividends.

Recommend a

"Cole" System

in your plant. It returns condensation back to the boilers HOT, up to 300 degrees F.—100 degrees hotter than is possible with a pump. *The fuel saving is enormous.*

Drop us a line and let us explain more fully.

Geo. W. Cole Co.

838 Dundas St., Toronto, Ont.

Trade Gossip

The Alliance Power Co. has recently been incorporated in Edmonton, Alta., with a capital of $250,000.

The Canadian Ice Machine Co., Toronto, have been awarded a contract for an ice plant for the hospital at Hamilton, Ont., at $3,645.

Essex, Ont.—The town council have awarded the contract for the supply of a deep well pump, fire pump and motors to Canadian Allis-Chalmers, Toronto. Approximate cost, $3,050.

The Cannuck Supply Co. has moved from 392 St. James St., Montreal, into new and enlarged quarters at 418 St. James street. This firm has recently added "King" metallic packing to their other lines. King packing is made by the United States Metallic Packing Co., of Philadelphia, Pa.

The Turbine Equipment Co., Toronto, Ont., have sold to the Nova Scotia Steel & Coal Co. a 1,000 h.p. De Laval marine type steam turbine, complete with double helical reduction gears, for installing in a new boat which is being built by the Steel Company. The company will also supply the condensing equipment, bilge and boiler feed pumps.

Montreal, Que.—The Roman Catholic School Board of Montreal, 87 St. Catherine West, will receive tenders up to May 23, 1916, for the erection of a school situated on Robin street. Tenders are called at the same time for the installation of a heating and ventilating system. Plans and specifications are with the Modern Heating and Engineering Co., 83 Bleury street. L. J. Bigonesse, 60 Notre Dame east, is the architect.

Crane Co. Products.—The Department of Mechanical Engineering of the University of Illinois has just received from the Crane Company, of Chicago, Illinois, through its representative, D. G. Park, an unusually complete and attractive exhibit of the product of this concern. It includes a number of very large valves, steam traps and other power specialties mounted on polished cast-iron floor pedestals, together with an oak display case mounting samples of the smaller valves, fittings and specialties. The completeness of the exhibit and the attractive way in which it has been prepared to permit the operation of the devices to be demonstrated, make the collection of unusual value to students in mechanical engineering.

The Turbine Equipment Co., Toronto, have recently secured a contract from the Imperial Oil Co., of Sarnia, Ont., for four single-stage De Laval centrifugal pumps, which will be direct-connected

Universal
LIQUID MEASURING
Devices

THE above cut is simply one of many types of measuring instruments, and we will be glad to supply instruments covering any class of liquid measuring on receipt of the following data:

1. Sp.G. of Liquid to be measured.
2. Depth of container.
3. Approximate location of container from Instrument.
4. Scale per foot of depth required on the instrument.
5. Maximum and minimum depths of liquid to be measured.
6. Whether the tank is exposed to frost.
7. Whether tank is vented.

On receiving information we will advise on best type of instrument.

This instrument measures the quantity of water or other liquid in a tank, well, stream or in almost any situation, and is absolutely free from mechanical devices, except for a small air pump at the instrument itself.

ALWAYS READY, ALWAYS SURE — ALWAYS KEEPS YOU POSTED ON THE QUANTITY OF LIQUID ON HAND, SAVES MUCH TIME AND PREVENTS "RUNNING SHORT."

Can be placed close to or far away from the liquid. It does not matter where the liquid to be measured is in relation to the device, as all you have to do is to run a piece of ¼ in. pipe from the tank to the instrument and the tank may be below or above ground, or hundreds of feet from the instrument, which latter is placed at any convenient position in the office or desired room.

Drop a line for circular and full particulars.

UNIVERSAL MEASURING DEVICES, Limited
125 ISABELLA STREET, TORONTO

SCALE FORMATION—
BAGGING PLATES—
CORROSION OF BOILER
TUBES AND PLATES—
BURNT TUBE ENDS—
LEAKY SEAMS—
SHUT DOWNS—
DELAYS—
NIGHT AND
SUNDAY WORK
HAND CLEANING
OF SCALE FILLED
TUBES—
BLISTERS—
REPAIRS—
WORRY—
FUEL WASTE—

You Won't See a Thing You Like On That List!

On the other hand you'll see a lot of things you don't like—a lot of things you'd like to avoid in the future. Some of them you've come to look upon as unavoidable but there isn't a single one that can't be eliminated from your plant and from your boilers if you go about it right.

"Going about it right" means using

Dearborn Treatment

For by the Dearborn method most internal boiler troubles can be successfully overcome—certainly all the troubles we have listed here.

Send us gallon sample of your feed supply for analysis and let us advise definitely regarding your special needs.

Dearborn Chemical Company of Canada
LIMITED
General Offices, Laboratories and Works:
1220-30 Dundas Street TORONTO, ONT., CANADA

Potato Scale Powder Boiler Cleanser

Makes and Keeps Boilers New in Efficiency and Economy

You cannot afford to let scale accumulate in your boilers because it reduces their efficiency, which means a larger amount of fuel is needed to produce desired steam pressure.

Your boilers will be clean all the time if you use a small quantity of Potato-Scale Powder in your feed water daily—there will be no foaming, pitting or any other troubles due to impurities in the feed water. **Potato Scale Powder Boiler Cleanser** is made to suit your feed water conditions, and contains nothing injurious to tubes or fittings.

Sold under a positive guarantee. **Try a barrel.**

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384. P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 977.

U.S. METAL POLISH

Works Equally Well on Hot and Cold Surfaces. It Cannot Blow Up. Cleans, Polishes and Preserves all kinds of metals.

Tear this off as a reminder

Geo. Wm. Hoffman Co.,
557 E. Wash. St.
Indianapolis, Ind.

Enclosed find 10c in stamps, for which send me one large 50c can of U. S. Metal Polish Paste.

Name ....
Address ....
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"In Service twelve years, re-ground at small expense and good for many more years of valve efficiency."

This is what one user says about

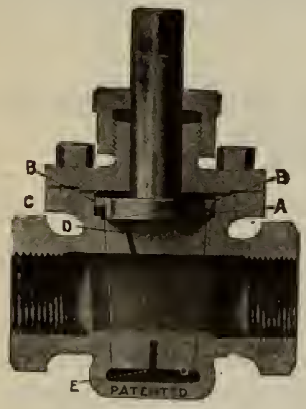
"Homestead"

QUARTER TURN VALVES

It will be decidedly to your advantage to specify Homestead Valves when placing your next order.

Once known — Always used.

Descriptive circulars yours for the asking.



Homestead Valve Mfg. Co.
PITTSBURGH, PA.
Works: Homestead, Pa.

KINDLY MENTION THIS PAPER WHEN WRITING ADVERTISERS

to 75 h.p. motors. The capacity of each unit is 3,750 gallons a minute, against 95 ft. total head. The company have also received an order from the Standard Chemical Co., of Toronto, for one 1¾ million-gallon De Laval centrifugal pump, to operate against 125 ft. total head.

Stresses in Boiler Heads.—The Babcock & Wilcox Co., of Bayonne, New Jersey, through its representative, Isaac Harter, general superintendent, has presented to the Department of Mechanical Engineering of the University of Illinois, a 42-inch cylindrical drum to be used in an investigation which has been undertaken by the Engineering Experiment Station to determine the stresses in convex boiler heads. One head is provided with a manhole, and the other, the head to be tested, is fastened to the shell by specially designed tapered bolts to facilitate its removal and replacement by heads of different design. The shell of the drum is made unusually heavy to permit pressures to be carried above those normally used in practice.

Catalogues

Blowing Engines made by the Mesta Machine Co., Pittsburgh, Pa., are dealt with in a catalogue recently issued. Some large installations are illustrated accompanied by a brief description.

The Babbitt Specialty Co., New Bedford Mass., have issued a leaflet illustrating and describing "Babbitt" adjustable sprocket rim for attaching to the wheel of any valve. A price list is included for rims and chains.

Homestead Valves.—A bulletin illustrating and describing various styles of valve made by the Homestead Valve Mfg. Co., Homestead, Pa., has been received. The essential points of these valves are dealt with fully and particularly with regard to the quarter-turn feature of their construction.

Steam Traps.—The George W. Cole Co., Toronto, Ont., have issued a new booklet illustrating and describing their line of boiler feed, return feed, lifting and vacuum traps. The illustrations include a diagram of a double trap installation. Other items include a price list, particulars of the "Cole" oil separator and a list of users of the "Cole" trap.

Air Heater and Air Blower.—Bulletin No. 219, issued by the B. F. Sturtevant Co., Boston, Mass., deals with the "Sturtevant" electric air heater and blower. The apparatus is fully described and the various purposes for which it can be used are given in detail. A list of sizes with capacities is included and the illustrations show a few different types indicating their varied application.

Classified Advertisements

WANTED

WANTED — DIRECT CURRENT MOTORS and generators. 110-250-500 Volt. Send detailed list to Box 189. The Power House. (5)

FOR SALE

FOR SALE—TWO HORIZONTAL RETURN tubular boilers 60" x 16', built to comply with Ontario Government specifications. Made in St. Catharines for a special order. Full particulars and details upon application to Taylor-Forbes Co., Ltd., Guelph, or Taylor-Forbes Co., 1088 King Street West. Toronto.

FOR SALE — TWO GOLDIE-McCULLOCH Wheelock Engines—cylinders 16" diameter, 38" stroke; both engines now running, but will be replaced with Hydro-Electric. Engines guaranteed to be in perfect condition, and will be sold complete with belt wheels, one 14' x 35" face and one 12' diameter with 24" face, also belting if required. Canadian Consolidated Felt Co., Berlin, Canada. (7)

THE PROPRIETORS OF LETTERS PATent No. 127080 relating to "Process of Manufacturing Iron Electrodes for use in Alkaline Accumulators" and No. 127081 relating to "Active Masses for Positive Electrodes of Electric Elements, etc.," desire to dispose of the Patents or to grant Licenses to interested parties at reasonable terms with a view to the adequate working of the Patents in Canada. Inquiries to be addressed to the actual proprietors, Svenska Ackumulator Aktiebolaget Jungner, Stockbolm, Sweden.

USED POWER EQUIPMENT.

ENGINES.

75 H.P., 16 x 36 Leonard Corliss, used less than year; heavy duty type.
85 H.P., 13 x 30 Brown automatic, excellent condition.
75 H.P., 12 x 30 Inglis Corliss
75 H.P., 12 x 12 Robb high-speed.
20 H.P. Robb high-speed.

BOILERS.

72 x 18 horizontal return tubular, shaking grates, Government inspected.

GENERATORS AND MOTORS.

200—300-light dynamos.
20, 25, 35, 250-volt motors.
50 H.P. gas engine and producer, good as new, at great bargain.
Hobbs & McGill, Mail Building, Toronto, Ont.

Electric Power Engines and Generators for Sale

1—Engine — H.P., 500; stroke, 24; bore, 22; generator; capacity 300 K.W.; 545 Amps.; 500 volts; Speed 150 R.P.M.

2—Engine — H.P., 320; stroke, 18; bore, 17; generator; capacity, 200 K.W.; 365 Amps.; 500 volts; speed 200 R.P.M.

All in good condition.

Apply

Box 192, The Power House

GENUINE
ARMSTRONG STOCKS AND DIES
MALLEABLE IRON HINGED PIPE VISES, PIPE CUTTERS, PIPE MACHINES.
MANUFACTURED BY
THE ARMSTRONG MFG. CO.
298 KNOWLTON STREET
BRIDGEPORT, CONN.
NEW YORK: 248 CANAL STREET

Dixon's Flake Graphite for Cylinder Lubrication

Using Dixon's Flake Graphite for cylinder lubrication means a reduction in the cost of lubrication, combined with better lubrication.

Although Graphite cannot be injected into cylinders through ordinary lubricators, there are several special devices on the market that successfully feed dry flake Graphite or mixtures of Graphite and oil. These devices soon pay for themselves by causing a wonderful saving in the cost of lubricants.

Booklet 222C gives full particulars and information. Send for it.

Made in JERSEY CITY, N.J., by the
JOSEPH DIXON
CRUCIBLE COMPANY
DXN Established 1827 DXN
C-104

Copies of this booklet may be had on application.

Detroit Stokers is the title of an attractive catalogue being distributed by the Detroit Stoker Co., Detroit, Mich., to feature the "Detroit" automatic mechanical stoker. Excellent illustrations show in detail the construction of this stoker and its principal features; its methods of operation are also described fully. Other illustrations of a similar quality show a large number of typical installations at various power plants. The "Detroit" stoker engine is illustrated and described and some useful efficiency tables, etc., are included.

Steam Saving Devices.—An interesting line of steam saving and protective devices are dealt with in catalogue No. 18 which is being distributed by the Strong, Carlisle & Hammond Co., Cleveland, Ohio. The specialties include steam and vacuum traps, separators, pump governors and pressure regulators, stop valves and engine stops, etc. Each appliance is described fully with special reference to its principal features. Sectional views are given showing the general construction and the method of operation is also described. Diagrams show some of the specialties installed and price lists with dimensions for the various sizes are included.

Nordberg Oil Engine.—Bulletin No. 27A deals with the high compression oil engine made by the Nordberg Mfg. Co., Milwaukee, Wis. The bulletin describes fully the "Nordberg" oil engine which is of two-cycle type and built in three sizes up to 200 h.p. This engine is claimed to be the simplest oil engine on the market and the principal features embodied in its construction and upon which this claim is based, are described fully. The bulletin contains a number of excellent half tones showing different views of the engine, detail sectional drawings and scavenging cards. Copies of the bulletin may be obtained on application.

MacKinnon, Holmes & Company, LTD
SHERBROOKE, QUE.
We build-
COAL BUNKERS
OIL TANKS
WATER TANKS
AIR RECEIVERS
and miscellaneous plate and structural work of every description used in connection with power plants.

Fetherstonhaugh & Co.
Patents Trade Marks and Designs in all countries
Canada Life Bldg., MONTREAL

Designer and builder of power and manufacturing plants, abattoirs, cold storage and packing house equipments. Factories constructed on the economy fire-proof plan. Ice-making plants and refrigeration installed.
GEORGE SCHAUTZ
Mechanical Engineer
BUFFALO, N.Y.
Office: 346 Ellicott Sq. Bell Phone, Seneca 3613-R.
Residence: 686 South Side Parkway
Bell Phone, Abbott 665-W.

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WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES
Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog
W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

WATER SOFTENING OR FILTRATION
FOR BOILER FEED AND ALL INDUSTRIAL USES
WM. B. SCAIFE & SONS CO. PITTSBURGH, PA.

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NOTICE

To Manufacturers, Dealers and Users of Steam Boilers

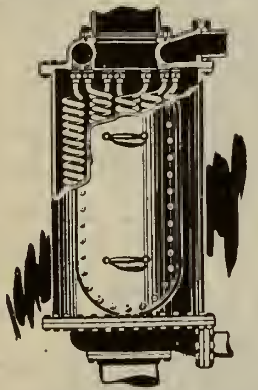
All steam boilers built in, or entering the Province of Ontario, and boilers exchanged or repaired are subject to Government Inspection as prescribed in the Steam Boilers Act, 3 George V., C. 61.

Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department, stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the Regulations by an Inspector authorized under the Act.

All communications should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G. MACDIARMID,
Minister of Public Works.

D. M. MEDCALF,
Chief Inspector of
Steam Boilers.



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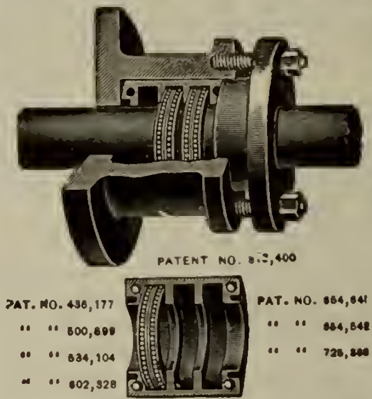

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TO
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Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

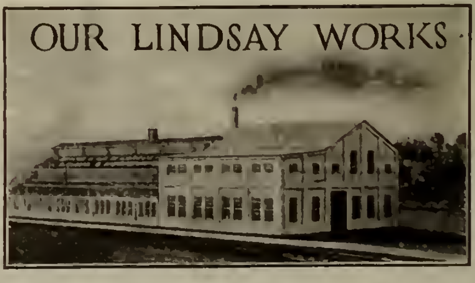
Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. JAS. S. DUFF,
MINISTER OF AGRICULTURE.

W. C. McGHIE,
CHAIRMAN OF BOARD.

Water Turbines, Hydraulic Governors, Centrifugal Pumps



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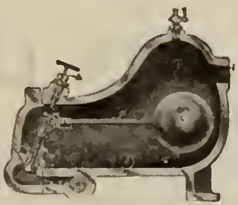

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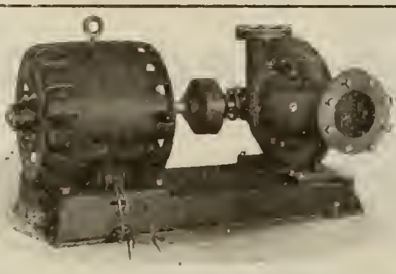

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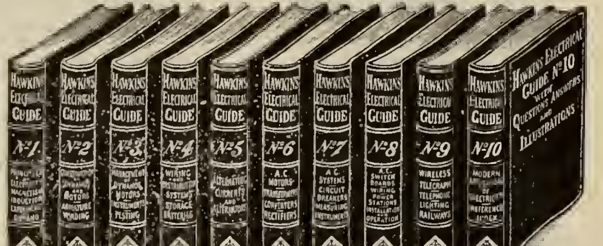
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These new Lagonda Cleaners are built for all sizes of tubes, either straight or curved, and they can be driven by water, air or steam.

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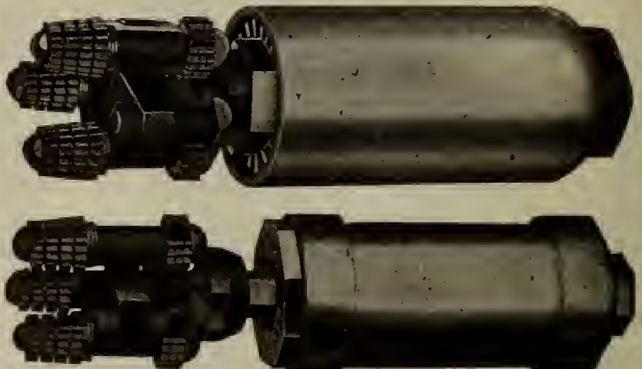

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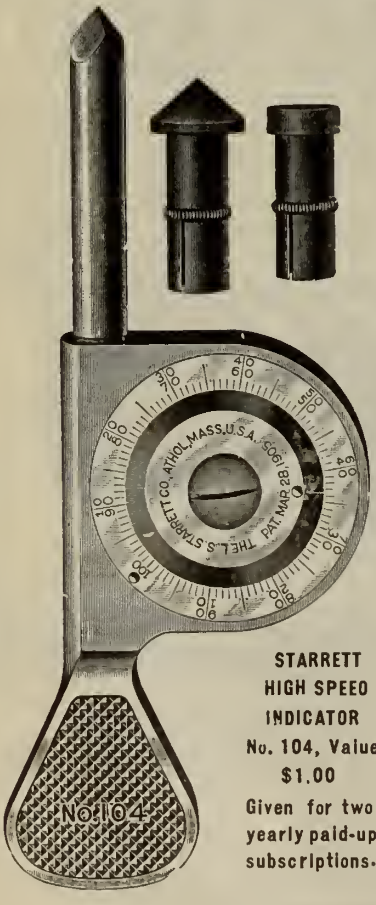

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American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Chaplin & Fulton Mfg. Co., Pittsburg, Pa.
Geo W Cole Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.

FILTERS
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.

FILTERS, WATER
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

FIRE HOSE
Quaker City Rubber Co., Philadelphia, Pa.

FIREPROOF COLD STORAGE DOORS AND WINDOWS
Jamison Cold Storage Door Co., Hagerstown, Md.

FLANGED STEAM FITTINGS
Direct Separator Co., Syracuse, N.Y.

FLANGES
Dart Union Co., Toronto.
Lunkenheimer Co., Cincinnati, O.

FLOORING COMPOSITION
Armstrong Cork & Insulation Co., Montreal, Que.

FLUE CLEANERS
Babcock & Wilcox, Ltd., Montreal.
William B. Pierece Co., Buffalo, N.Y.
Roto Co., Hartford, Conn.

FLUE GAS ANALYSIS INSTRUMENTS
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York.

FLUMES, STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

FREEZER DOORS
Jamison Cold Storage Door Co., Hagerstown, Md.

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FURNACES, BOILER
Gates, J. W., Montreal, P.Q.

FURNACES, STEEL HEATING
Hare Engineering Co., Toronto.

FUSES, RENEWABLE
Monarch Refillable Fuse Co., Hamilton, Ont.
Economy Fuse & Mfg. Co. of Canada, Montreal.

GAS ANALYSIS INSTRUMENTS, ETC.
William R. Pierce Co., Buffalo.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

GASKETS, RUBBER, ASBESTOS, LEAD COPPER AND LEATHER
Frick Co., Waynesboro, Franklin Co., Pa.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

GAS PRODUCER PLANTS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

GAUGE COCKS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.

GAUGES, AMMONIA, OIL, GAS, AIR
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GAUGES, PRESSURE, VACUUM, DRAFT AND RECORDING
Babcock & Wilcox, Montreal.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

GAUGES, WATER
Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

GEARS, CUT, WORM, MORTISE
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

GENERATORS, STEAM TURBO
Hare Engineering Co., Toronto.
Laurie & Lamb, Montreal.

GENERATORS AND CONVERTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Terry Steam Turbine Co., Hartford, Conn.

GOVERNORS, ENGINE
Waterous Engine Works Co., Brantford.

GRAPHITE, BOILER
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

GRAPHITOL
C. C. Snowdon, Calgary.

GRATES, DUMPING, ROCKING, STATIONARY
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Can. Steam Boiler Equipment Co., Toronto.
Galt Foundry Co., Galt, Ont.
Hare Engineering Co., Toronto.
Geo. H. Tod, Toronto.
Waterous Engine Works Co., Brantford.

GREASE CUPS
Albany Lubricating Co., New York City.
Detroit Lubricator Co., Walkerville.
Hamilton Brass Mfg. Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto

GREASE AND OIL EXTRACTORS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Griscom-Russell Co., Ltd., Montreal.
Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Laurie & Lamb, Montreal.
C. C. Snowdon, Calgary.

GREASES
Albany Lubricating Co., New York City.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

HAND LEATHERS OR PADS
Graton & Knight Mfg. Co., Montreal.

HANGERS
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

HEATERS
Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Ltd., Montreal
Canadian Griscom-Russell Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Geo. W. Cole Co., Toronto.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.

HEATING SYSTEMS, FANS
Can. Sirocco Co., Windsor, Ont.

HOISTING AND CONVEYING MACHINERY
Babcock & Wilcox, Ltd., Montreal.
Waterous Engine Works Co., Brantford.

HOSE, STEAM, SUCTION AND WATER
Can. H. W Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

HYDRAULIC ACCUMULATORS
Smart-Turner Machine Co., Ltd., Hamilton.

HYDRAULIC MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
John McDougall Caledonian Iron Works, Montreal.

HYDRAULIC PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

ICE MAKING MACHINERY
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co.
Huetteman & Cramer Co., Detroit.
Linde Canadian Refrigeration Co., Montreal.
York Mfg. Co., York, Pa.

INSULATORS
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Geo. H. Tod, Toronto.

INDICATORS ELECTRIC—ALL TYPES
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

INDICATORS, STEAM AND GAS ENGINE
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Uehling Instrument Co., New York, N.Y.

INDICATORS—AMMONIA, HYDRAULIC
Can. Detroit Lubricator Co., Walkerville, Ont.

INDICATORS, SPEED
L. S. Starrett Co., Athol, Mass.

INJECTORS
Babcock & Wilcox, Ltd., Montreal.
Federal Engineering Co., Toronto, Ont.
Hamilton Brass Mfg. Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Penberthy Injector Co., Windsor.

INSULATING BRICK
Armstrong Cork & Insulation Co., Montreal, Que.

IRON FILLER
Can. H. W. Johns-Manville Co., Ltd., Toronto.

LACE LEATHERS
Graton & Knight Mfg. Co., Montreal.

LAMPS, ARC, INCANDESCENT
Canadian Fairbanks-Morse Co., Ltd., Montreal.

LEATHER STRAPPING
Graton & Knight Mfg. Co., Montreal.

LUBRICANTS
Albany Lubricating Co., New York City.
Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

LUBRICATORS, CYLINDER
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.

LUBRICATORS, FORCE FEED
Darling Bros., Montreal.
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

LUBRICATORS, PLAIN
Can. Detroit Lubricator Co., Walkerville, Ont.
Hamilton Brass Mfg. Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.

MACHINERY INSULATION
Armstrong Cork & Insulation Co., Montreal, Que.

MAGNETS, LIFTING, GENERATORS
Terry Steam Turbine Co., Hartford, Conn.

MECHANICAL STOKERS
Babcock & Wilcox, Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Detroit Stoker Co., Detroit.
Hare Engineering Co., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

METERS, WATER
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.

MILL AND MINING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jenckes Machine Co., Sherbrooke, Que.
Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

MOLDS, RUBBER
Bawden Machine Co., Toronto.

MOTORS
Canadian Fairbanks-Morse Co., Ltd., Montreal.

MOTOR STARTERS AND CONTROLLERS
Terry Steam Turbine Co., Hartford, Conn.

OFFICE RAILINGS
Jas. Morrison Brass Mfg Co., Toronto.

OIL CUPS
Albany Lubricating Co., New York City.
Hamilton Brass Mfg. Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

OILERS, GAUGE
Lunkenheimer Co., Cincinnati, O.

OILERS, MULTIPLE
Can. Detroit Lubricator Co., Walkerville, Ont.
Lunkenheimer Co., Cincinnati, O.

OIL FILTERS AND CIRCULATING SYSTEMS
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
Jas. Morrison Brass Mfg. Co., Toronto.

OIL SEPARATORS
Babcock & Wilcox, Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Geo. W. Cole Co., Toronto.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

OILING SYSTEMS
Albany Lubricating Co., New York City.
Lunkenheimer Co., Cincinnati, O.

OILS, LUBRICATING
Albany Lubricating Co., New York City.
C. C. Snowdon, Calgary.

PACKING, ENGINE
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

PACKING, HYDRAULIC
Garlock Packing Co., Hamilton, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

PACKING, METALLIC
Greene, Tweed & Co., New York.
Holmes Metallic Packing Co., Wilkesbarre, Pa.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

PACKING, ROD
Garlock Packing Co., Hamilton, Ont.
Steel Mill Packing Co., Windsor, Ont.
Quaker City Rubber Co., Philadelphia, Pa.

PACKING, SHEET
Garlock Packing Co., Hamilton, Ont.
Jenkins Bros., Ltd., Montreal.
Quaker City Rubber Co., Philadelphia, Pa.

PACKING, AMMONIA, STEAM AND WATER
Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
Quaker City Rubber Co., Philadelphia, Pa.
Steel Mill Packing Co., Windsor, Ont.

PACKING, LEATHER
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.

PENSTOCKS
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

PILLOW BLOCKS
Waterous Engine Works Co., Brantford.

PIPE COILS
York Mfg. Co., York, Pa.

PIPE THREADING AND CUTTING MACHINES (HAND, BELT AND MOTOR)
Borden Canadian Co., Toronto.
Oster Mfg. Co., Cleveland, O.

PIPE COVERINGS, STEAM, BRINE, AMMONIA AND ICE WATER
Armstrong Cork & Insulation Co., Montreal, Que.

PIPE STEEL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPE VISES AND CUTTERS
Armstrong Mfg. Co., Bridgeport, Conn.

PIPES, WATER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PIPING AND FITTINGS
Frick Co., Waynesboro, Franklin Co., Pa.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
York Mfg. Co., York, Pa.

PIPING, STEAM
Babcock & Wilcox, Montreal.

PLATE WORK
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

POLISH, METAL
G. W. Hoffman, Indianapolis.

POWER PUMPS
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
Waterous Engine Works Co., Brantford.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Canada.
Laurie & Lamb, Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.

POWER, TRANSMISSION MACHINERY
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Jenckes Machine Co., Sherbrooke.
MacGovern & Co., New York.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Morse Chain Co., Ithaca, N.Y.
Waterous Engine Works Co., Brantford.

PRESSES
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.

PRESSURE, BLOWERS, CENTRIFUGAL
Can. Sirocco Co., Windsor, Ont.

PULLEYS
American Pulley Co., Philadelphia, Pa.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY
American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.
Waterous Engine Works Co., Brantford.

PUMPING MACHINERY, ELECTRICAL
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Hamilton, Ont.
Terry Steam Turbine Co., Hartford, Conn.

PUMP GOVERNORS AND REGULATORS
Bawden Machine Co., Ltd., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
Elliott Co., Pittsburgh, Pa.
Mason Regulator Co., Boston, Mass.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

PUMP STRAINERS
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal, Que.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

PUMPS, AIR
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Terry Steam Turbine Co., Hartford, Conn.
Wheeler Condenser & Engineering Co., Carteret, N.J.

PUMPS, CONTRACTORS'
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Terry Steam Turbine Co., Hartford, Conn.

PUMPS, HAND AND POWER
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal, Que.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Hamilton, Ont.
Stewart Heater Co., Buffalo, N.Y.

PUMPS, CENTRIFUGAL
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal, Que.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.
Turbine Equipment Co., Toronto.
Waterous Engine Works Co., Brantford.
Wheeler Condenser & Engineering Co., Carteret, N.J.

PUMPS, GEARED, COMPOUND
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

PUMPS, HYDRAULIC, PRESSURE
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Darling Bros., Ltd., Montreal, Que.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Terry Steam Turbine Co., Hartford, Conn.

PUMP LEATHERS
Graton & Knight Mfg. Co., Montreal.

PUMPS, OIL
Bawden Machine Co., Ltd., Toronto.
Can. Detroit Lubricator Co., Walkerville, Ont.
Hamilton Brass Mfg. Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

PUMPS, STEAM TURBO
Darling Bros., Ltd., Montreal, Que.
Hare Engineering Co., Toronto.

PUMPS, STEAM
American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Montreal.
Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.

The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.

PUMPS, TRIPLEX

Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.

PUMPS, VACUUM

American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Toronto,
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.
Terry Steam Turbine Co., Hartford, Conn.
Wheeler Condenser & Engineering Co., Carteret, N.J.

PUMP TANK, RECEIVER

American Steam Pump Co., Battle Creek, Mich.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.

PYROMETERS

Jas. Morrison Brass Mfg. Co., Toronto.
Uehling Instrument Co., New York, N.Y.

RADIATOR STEAM TRAPS

Stewart Heater Co., Buffalo, N.Y.

RADIATOR AIR VENTS

Jas. Morrison Brass Mfg. Co., Toronto.

REBOILERS

Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

RECORDING INSTRUMENTS

Uehling Instrument Co., New York, N.Y.

REFRIGERATOR DOORS, WINDOWS, ETC.

Jamison Cold Storage Door Co., Hagerstown, Md.

REFRIGERATING MACHINERY

Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Griscom-Russell Co., Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Huetteman & Cramer Co., Detroit.
Linde Canadian Refrigeration Co., Montreal.
Vilter Mfg. Co., Milwaukee, Wis.
York Mfg. Co., York, Pa.

REFUSE DESTRUCTOR

Canadian Griscom-Russell Co., Ltd., Montreal.
Laurie & Lamb, Montreal.

REGULATORS, PRESSURE

Jas. Morrison Brass Mfg. Co., Toronto.

RETORTS

MacKinnon, Holmes & Co., Sherbrooke, Que.

REVOLVING DOORS FOR HARDENING ROOMS

Jamison Cold Storage Door Co., Hagerstown, Md.

ROOFINGS—ASBESTOS AND WOOL FELTS

Can. H. W. Johns-Manville Co., Ltd., Toronto.

ROPE PRESERVATIVE

Cling Surface Co., Buffalo.

ROTARY CONVERTERS

Canadian Fairbanks-Morse Co., Montreal.

RUBBER GOODS

Quaker City Rubber Co., Philadelphia, Pa.

RUBBER HOSE

Can. H. W. Johns-Manville Co., Ltd., Toronto.
Garlock Packing Co., Hamilton, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
Quaker City Rubber Co., Philadelphia.

RUBBER MOLDS

The Bawden Machine Co., Toronto.

SAFES

Canadian Fairbanks-Morse Co., Montreal.
Goldie & McCulloch Co., Galt.

SCALE REMOVERS

Babcock & Wilcox, Ltd., Montreal.
Can. H. W. Johns-Manville Co., Ltd., Toronto.
William B. Pierce Co., Buffalo, N.Y.
Roto Co., Hartford, Conn.

SEPARATORS, OIL, STEAM AND AMMONIA

Babcock & Wilcox, Ltd., Montreal.
Frick Co., Waynesboro, Franklin Co., Pa.
Smart-Turner Machine Co., Hamilton, Ont.
York Manufacturing Co., York, Pa.

SHAFTING

Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SHAKING AND DUMPING GRATES

Babcock & Wilcox, Ltd., Montreal.
Can. Steam Boiler Equipment Co., Toronto.
Galt Foundry Co., Galt, Ont.
Waterous Engine Works Co., Brantford.

SMOKE BOXES, STACKS

Babcock & Wilcox, Ltd., Montreal.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

SMOKELESS FURNACES

Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

SPECIAL MACHINERY

The Bawden Machine Co., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Waterous Engine Works Co., Brantford.

SPEED INDICATORS

Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
L. S. Starrett Co., Athol, Mass.

SPROCKET CHAIN ATTACHMENTS

Waterous Engine Works Co., Brantford.

SPROCKET RIMS

Babbitt Steam Specialty Co., New Bedford, Mass.

SPUR WHEELS

Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Waterous Engine Works Co., Brantford.

STACKS, STEEL

Babcock & Wilcox, Ltd., Montreal.

STAND PIPES, STEEL

William Hamilton Co., Ltd., Peterborough, Ont.
MacKinnon, Holmes & Co., Sherbrooke, Que.

STEAM SEPARATORS

Babcock & Wilcox, Ltd., Montreal.
Canadian Fairbanks-Morse Co., Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Penberthy Injector Co., Windsor.
Smart-Turner Machine Co., Hamilton, Ont.
Watson & McDaniel Co., Philadelphia.

STEAM SPECIALTIES

Alberger Heater Co., Buffalo, N.Y.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
Geo. W. Cole Co., Toronto.
Darling Bros., Montreal.
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
Watson & McDaniel Co., Philadelphia, Pa.

STEAM TRAPS

American Steam Gauge & Valve Mfg. Co., Boston, Mass.
V. D. Anderson Co., Cleveland, O.
Canadian Fairbanks-Morse Co., Montreal.
Can. Duplex Steam Trap Co., Walkerville, Ont.
Can. Sirocco Co., Windsor, Ont.
Geo. W. Cole Co., Toronto.
Darling Bros., Montreal.
G. M. Davis Regulator Co., Chicago.
Elliott Co., Pittsburgh, Pa.
Can. Morehead Mfg. Co., Woodstock.
Watson & McDaniel Co., Philadelphia, Pa.

STEEL BARRELS

Smart-Turner Machine Co., Hamilton, Ont.

STEEL DRUMS

Smart-Turner Machine Co., Hamilton, Ont.

STEEL TANKS

Babcock & Wilcox, Ltd., Montreal.

STOKERS

Babcock & Wilcox, Ltd., Montreal.
Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Hare Engineering Co., Toronto.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Manning Chambers, Toronto.

STOP COCKS

Hamilton Brass Mfg. Co., Hamilton, Ont.

STRAINERS

Babcock & Wilcox, Ltd., Montreal.
Bawden Mach. Co., Toronto, Ont.
Elliott Co., Pittsburg, Pa.

STRUCTURAL STEEL WORK

Babcock & Wilcox, Ltd., Montreal.

SUPERHEATERS, STEAM

Babcock & Wilcox, Ltd., Montreal.

TACHOMETERS

Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

TANKS, BLOW-OFF

Darling Bros., Montreal.
John McDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

TANKS, FREEZING, STORAGE AND WATER COOLING

Frick Co., Waynesboro, Franklin Co., Pa.

TANKS, OIL

Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

TANKS, WATER

MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford, Ont.

TECHNICAL BOOKS

Waterous Engine Works Co., Brantford, Ont.
MacLean Publishing Co., Toronto.

THERMOMETERS

Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
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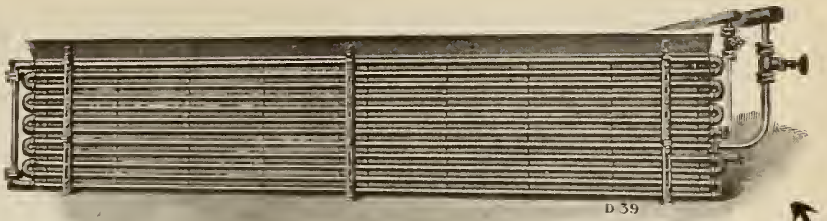

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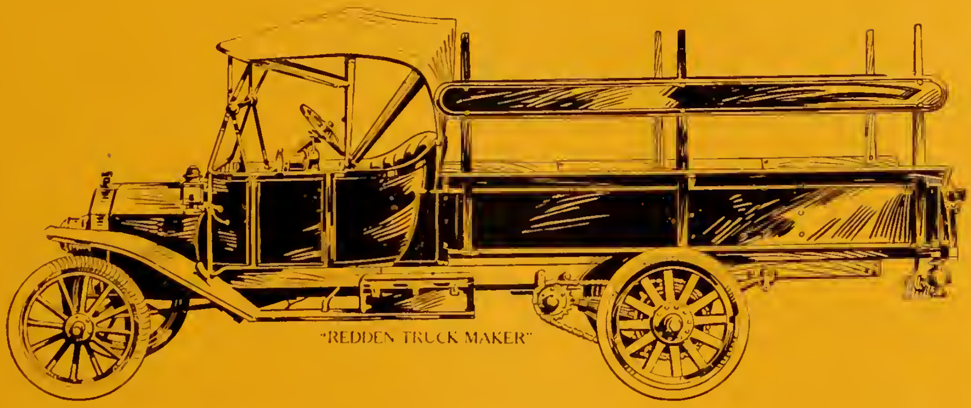

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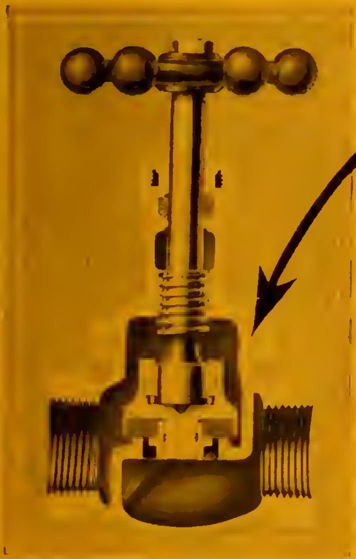

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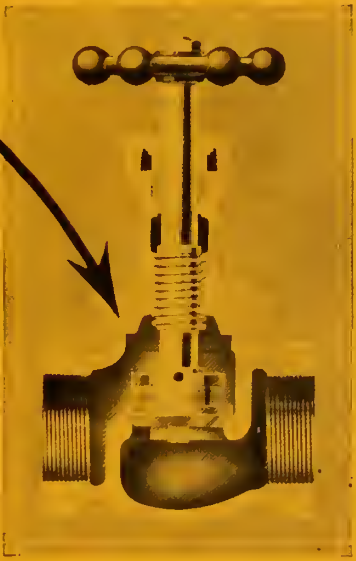

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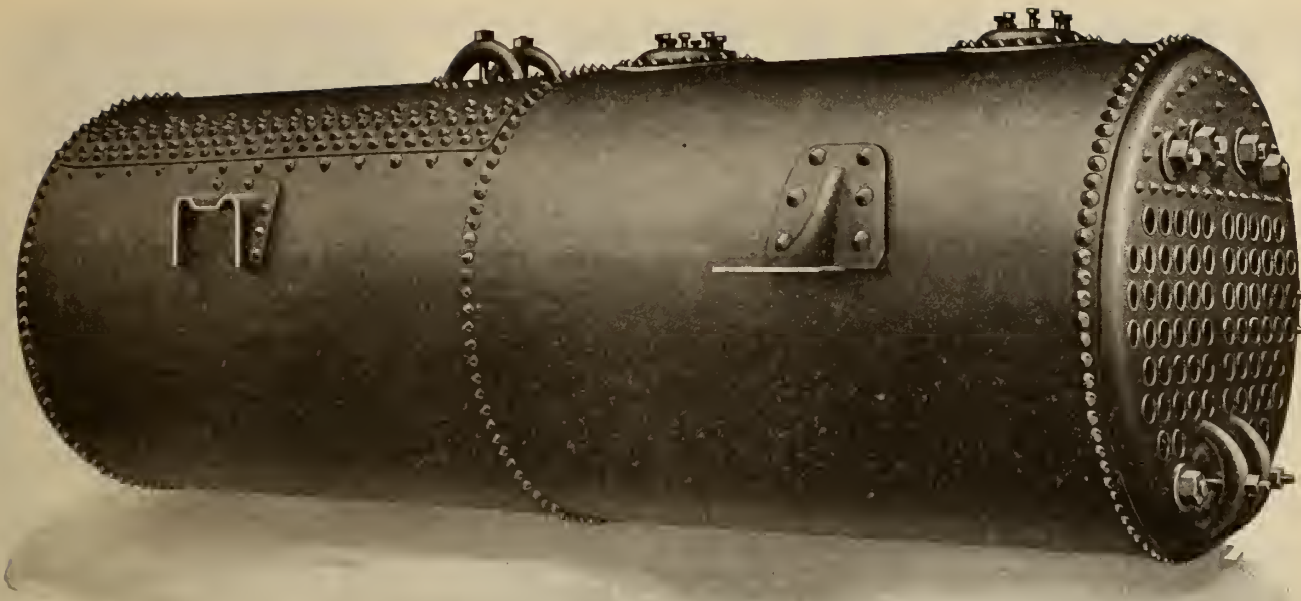

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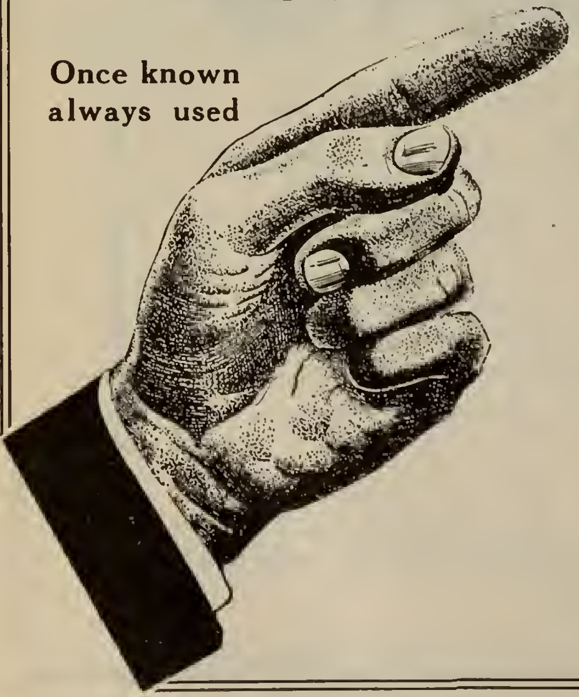

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Is especially designed for use in gas engines, gasoline engines, and all classes of marine engines, and is especially adapted for automobile engines.

If you cannot get these babbitts from your dealer, we will be pleased to make you a shipment direct of a twenty-five-pound box.

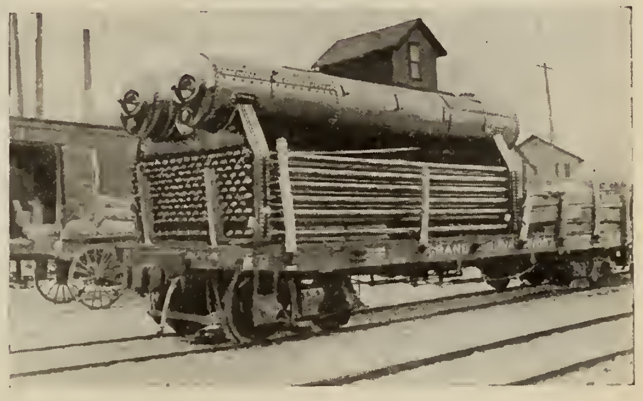
OVER $5,000,000 WORTH SOLD ANNUALLY.

HOYT METAL COMPANY

Factory and Offices:
EASTERN AVENUE and LEWIS STREET, TORONTO, ONTARIO
New York, N.Y. London, Eng. St. Louis, Mo.

We Build:

WATER TUBE BOILERS like this



HORIZONTAL RETURN TUBULAR BOILERS

Standard or Special like this

Also all kinds of Marine Boilers, Land Boilers, Plate Work, etc.

And ALL KINDS OF TANKS like this

Send us your specifications and blue prints.

POLSON IRON WORKS, LIMITED

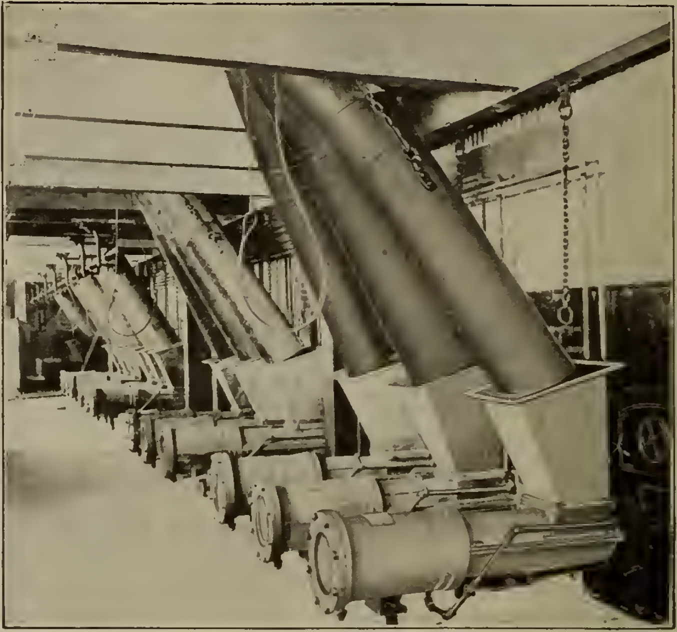
SHIPBUILDERS, ENGINEERS AND BOILER MAKERS

TORONTO, ONTARIO

1892-1916

For more than twenty years Jones Stokers have been used in every line of industry where a regular and dependable supply of steam is essential. These years have proved beyond question the sturdiness and economy of

Jones Underfeed Stokers



Hundreds of these Stokers are making fuel savings from 15% to 25% in plants like your own.

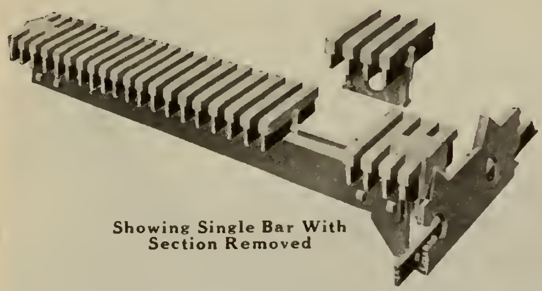
They are the simplest stokers built: few parts and none moving in contact with the fire; no grates; no losses through grates.

The cost of the Jones Underfeed Stoker is moderate, and besides you'll get it back and *more* from the saving in coal.

Learn ALL about it. Descriptive catalogs are yours for the asking.

JONES UNDERFEED STOKER COMPANY, LIMITED
National Trust Building, Toronto

LONG LIFE HIGH EFFICIENCY LOW REPAIRS



Showing Single Bar With Section Removed

The McNaughton Rocking Sectional Grate Bar

Specially designed to burn all grades of fuel and lignite.

—Used in—

OVER 1000 POWER PLANTS

Developing Nearly 200,000 Horse Power

A Few Recent Installations

Western Canada Flour Mills, Limited, Goderich, Ont.	6 Sets
Western Canada Flour Mills, Limited, Brandon, Man.	3 "
Grand Trunk Railway System (3000 H.P.)	12 "
Standard Chemical Iron & Lumber Co., Ltd., Cookshire, P.Q.	4 "
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North American Chemical Co., Goderich, Ont.	4 "
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Richardson Elevator Co., Kingston, Ont.	2 "
W. J. Crothers Co., Limited, Kingston, Ont.	3 "
National Steel Car Co., Ltd. (1500 H.P.), Hamilton, Ont.	5 "
Dominion Canners, Limited	4 "
Great Lakes Transportation Co.	9 "
Preston Car & Coach Co., Limited, Preston, Ont.	3 "
Spanish River Pulp & Paper Co., Sturgeon Falls, Ont. (700 H.P.)	2 "
Newlands & Co., Limited, Galt, Ont.	4 Sets
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The Pedlar People, Limited, Oshawa, Ont.	3 "
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All goods sold on thirty days **FREE TRIAL.** The Grate that has given universal satisfaction.

GALT FOUNDRY CO., **Manufacturers** **GALT, ONTARIO**

Murphy AUTOMATIC Furnace

Six Well-Known High-Class Canadian Corporations

Executed TWENTY CONTRACTS for Murphy Furnaces.
(14 repeat orders—56 furnaces—18,664 nominal H.P.)

X indicates REPEAT ORDERS in 1916 !

LAURENTIDE PAPER COMPANY (11 years' experience), Grand Mere, P.Q.			
1st order,	March, 1905	9 furnaces,	2300 HP.
2nd "	July, 1907	2 "	700 HP.
3rd "	April, 1912	2 "	800 HP.
4th "	May, 1912	1 "	400 HP.
X5th "	May, 1916	1 "	400 HP.
		15 furnaces,	4600 HP.
SPANISH RIVER PULP & PAPER CO., Espanola, Ont.			
1st order,	April, 1911	4 furnaces,	1120 HP.
2nd "	January, 1913	2 "	600 HP.
X3rd "	March, 1916	2 "	600 HP.
		8 furnaces,	2320 HP.
LAKE SUPERIOR PAPER CO., Sault Ste. Marie, Ont.			
1st order,	July, 1911	13 furnaces,	4250 HP.
2nd "	June, 1912	2 "	1000 HP.
X3rd "	April, 1916	1 "	500 HP.
		16 furnaces,	5750 HP.
ONTARIO PAPER COMPANY, Thorold, Ont.			
1st order,	Sept., 1912	4 furnaces,	1332 HP.
2nd "	Aug., 1914	1 "	330 HP.
X3rd "	Feby., 1916	2 "	666 HP.
X4th "	April, 1916	2 "	666 HP.
		9 furnaces,	2994 HP.
DONNACONNA PAPER COMPANY, LTD., Donnaconna, P.Q.			
1st order,	Feby., 1913	2 furnaces,	600 HP.
2nd "	June, 1913	1 "	300 HP.
X3rd "	March, 1916	3 "	900 HP.
		6 furnaces,	1800 HP.
BEAVER FIBRE BOARD CO., Thorold, Ont.			
1st order,	May, 1913	2 furnaces,	600 HP.
X2nd "	Feby., 1916	1 "	300 HP.
		3 furnaces,	900 HP.

THERE MUST BE A REASON—for the 14 REPEAT ORDERS !

If you want to profit by their experience, write to-day for catalogue and list of Canadian installations.

MURPHY IRON WORKS, DETROIT, MICH.
BUFFALO, N. Y.

This Pound of Coal

is Capable of Sustaining a Horse-power for nearly an Hour.

EVERY pound of coal contains a definite amount of potential energy—combustion liberates it in the form of heat energy—eventually, mechanical motion.

Even in passenger locomotive service (notoriously wasteful in energy transmission) a pound of coal will develop a horse-power for 20 or 25 minutes.

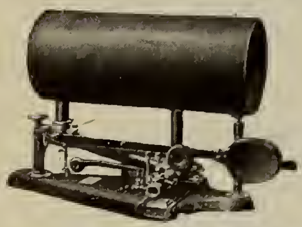
With this in mind imagine an installation of the

Morehead
Back to Boiler
SYSTEM

saving, daily, from 2,000 to 30,000 pounds of coal—paying for itself in a few months' time. This is the experience of hundreds of engineers using steam for heating, drying or cooking purposes.

The Morehead System keeps steam heated equipment absolutely free of condensation—returning **under pressure** the chemically pure hot condensation to the boilers as feed water.

Ask for particulars applying to your individual requirements. Our experts will be glad to work with you on any job you have which involves the use of steam in any way.



Canadian Morehead Manufacturing Co.
Woodstock Dept. "J" Ontario

An enormous percentage of the oil you put on machinery is not consumed, but wasted on saturated floors, rags, waste, etc.

OIL CAN BE USED OVER AND OVER AGAIN UNTIL ENTIRELY CONSUMED, and the oil expense greatly reduced. It is simply a matter of collecting it in drip pans located beneath the engine or machinery and passing it on to

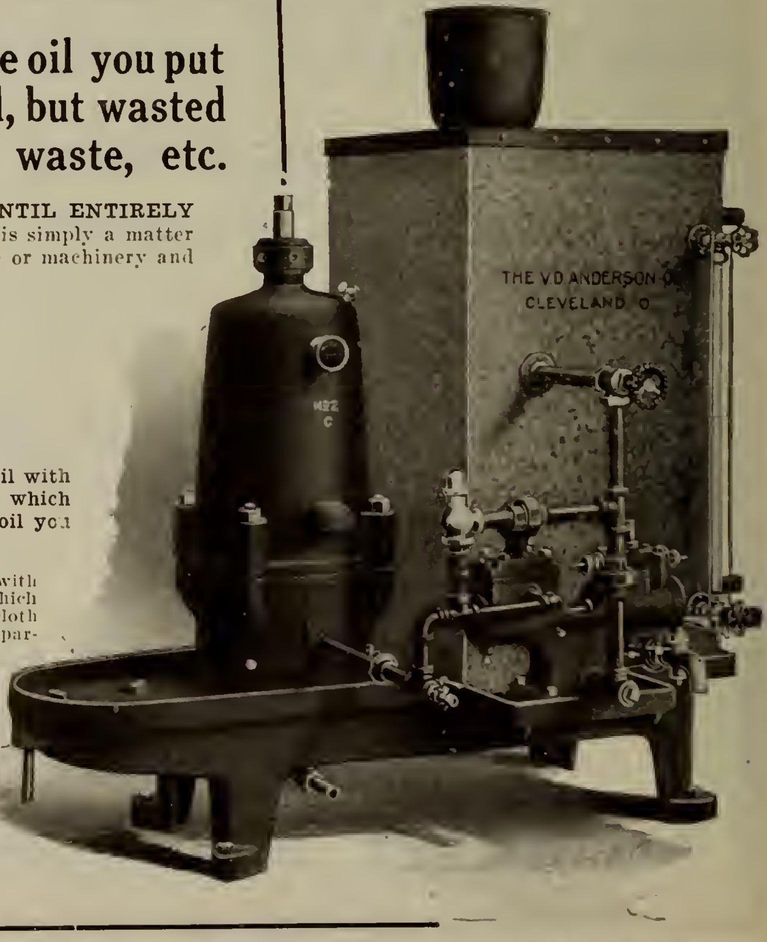
The "Anderson" Pressure Oil Filters

The Anderson Filter is the only one which treats the oil with the refiner's process, and is therefore the only filter which can deliver the oil just as clean and pure as the new oil you purchase.

This new Anderson Process should not be confused with gravity or drip equipment. It is a filter press through which the oil is forced by direct pressure through either filter cloth or filter paper sufficiently heavy to extract the finest particles of grit.

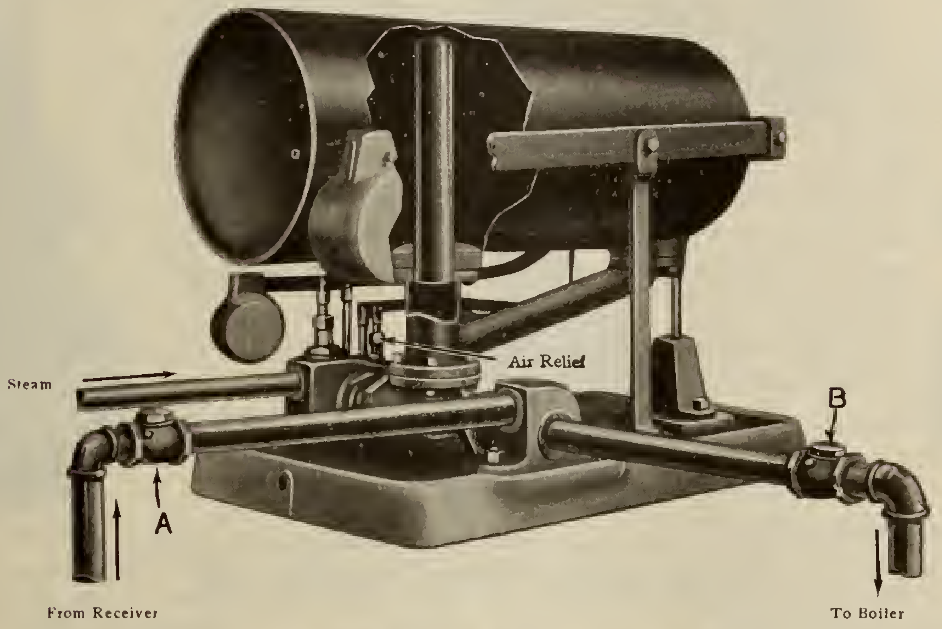
The filtering medium is held firmly in position between rings and plates, and being much heavier than can be employed with the gravity of straining process, **IT GIVES FAR BETTER RESULTS.**

WRITE FOR FULL DETAILS.



The V. D. Anderson Co.
West 96th Street - Cleveland, Ohio

Nothing Mysterious about a Detroit Trap Every Working Part is on the Outside



"Detroit" STEAM TRAPS

Some Facts You Should Know About Them

1. Nothing inside the tank to rust, corrode or give trouble—all working parts are on the outside and interchangeable.
2. Large water-handling capacities for space required. Will handle water at a higher temperature than a pump will lift.
3. Properly constructed — properly assembled and thoroughly tested before shipment.
4. Increase efficiency of steam coils or steam-heated machinery by keeping all lines free and clear of condensation.

These are only four of the reasons why "Detroit" Traps save money for the user. Trap catalogue No. 352 gives all information—capacities—sizes, etc. Write the home office or any sales office.

CANADIAN Sirocco COMPANY
LIMITED

WINDSOR, ONTARIO.

SALES OFFICES

S. S. Clarke,
605 2nd St.,
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567 Banning St.,
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Canadian Steam Specialty
Sales Co.,
526 Traders Bank Bldg.,
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Phone Main 5118

Canadian Sirocco Company, Ltd.,
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KERR

("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

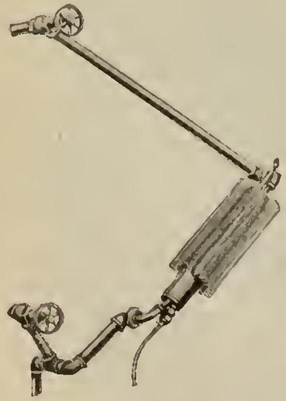
When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the " Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

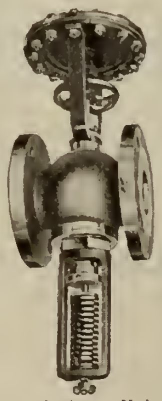
Mechanical Regulation of Boiler Feed Water

By the use of the "S-C" method you are assured of a continuous feed at all times load is on boiler. The graduation in rate of feeding is entirely dependent upon the load and fire conditions. The Regulator will carry a constant level on steady load—higher level on light load and lower level on peak loads. Variation in water level is entirely dependent on inclined position of generator which is adjustable while operating under full load.

Bulletin No. 21 explains all.



Generator or Actuating end of Regulator.



Regulating Valve Placed at Any Point, Any Position.

The "S-C" Regulator Company
FOSTORIA, OHIO, U.S.A.

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.
CANADIAN AGENTS
H. L. PEILER & CO., MONTREAL and TORONTO

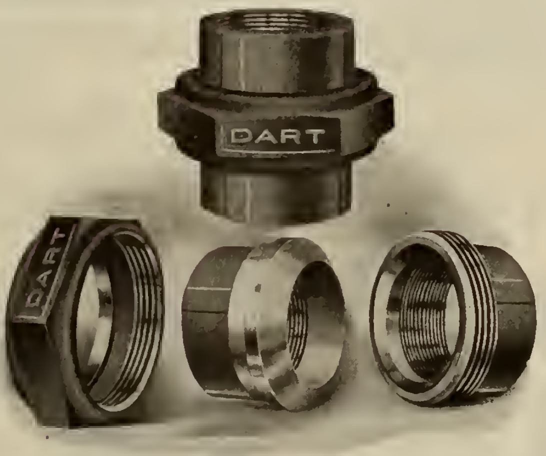
DART

UNIONS

Bronze to Bronze
at the joint
—No deterioration

Heavy Iron Parts
—No stretching or pulling apart

Easily Connected
—whether pipes are in or out of line



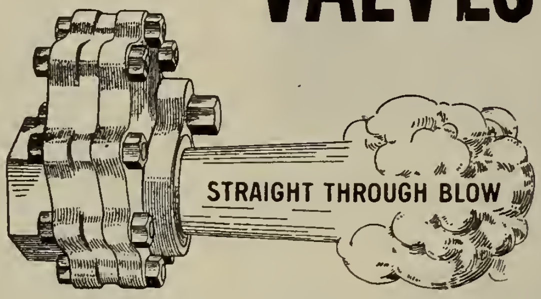
No upkeep cost, no replacement cost and no loss from leaks.

Sold by all first-class supply houses

Made in Canada by

DART UNION COMPANY, LIMITED
TORONTO, CANADA

EVERLASTING Blow-Off VALVES



"EVERLASTING" Blow-Off Valves will immediately end your blow-off leaks or troubles.

No Packing.

No Stuffing Box.

Self-Grinding Seat.

Self-Cleaning.

—NOTHING TO GET OUT OF ORDER.

Over 220,000 in use

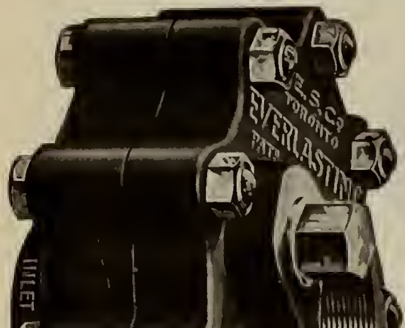
The *Everlasting Valve*—endorsed by leading Consulting Stationary and Marine Engineers.

Accepted by Boiler Inspection Insurance Companies.

Approved by all Provincial Governments requiring High Pressure Valves and Accessories to be registered and recorded. Provincial Record Numbers furnished on request.

OUR GUARANTEE—Satisfaction guaranteed or money refunded within one year.

Not guaranteed against galvanic action or corrosive acid.



Write for New Catalog No. V-15

Look for this ☞MARK

The word "EVERLASTING" is on every genuine "EVERLASTING" Blow-Off Valve — it's your safeguard against imitations.

Sold and Manufactured under Canadian Patents by

ENGINEERING SPECIALTIES COMPANY, Limited

1080 King St. West, Toronto

MONTREAL, QUE.
H. L. Peiler & Co.
VANCOUVER, B.C.
Taylor-Forbes Co., Ltd.
HAMILTON, ONT.
Dugald Turner, 110 Lister Chambers.

CALGARY, ALTA.
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The A. R. Williams Mach. Co.
TRURO, N.S.
W. Davidson

No Troublesome Floats

The Vigilant Feed Water Regulator has no floats in its construction, for the best of floats, with all their guarantees, will leak and become water logged or collapse, in spite of all arguments to the contrary. Under heavy pressure the water seems to penetrate the pores of the metal. The Vigilant has no floats, no diaphragms, no complicated system of levers and small valves, no concealed or obscure steam passages.

Write for Description

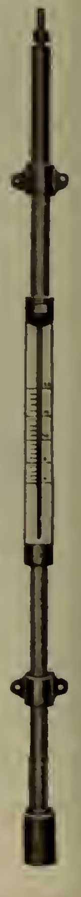
The Chaplin-Fulton Manufacturing Co.

28 Penn Ave., Pittsburgh, Pa.

UEHLING WASTE METER

COMBINED

CO_2 AND TEMPERATURE RECORDER



Does your fireman know how much fuel he is wasting? Do you know?

Record of CO2 and stack temperature on one chart.

The **Uehling CO_2 Recorder** makes a complete 24 hr. record of your combustion efficiency and the CO2 indicator at the Boiler Front holds the fireman responsible.

Get more **Steam** per pound of **Coal** and reduce your annual fuel consumption.

Let us know the number and size of your boilers and coal consumed per year, upon receipt of which information we will be glad to send you full particulars.

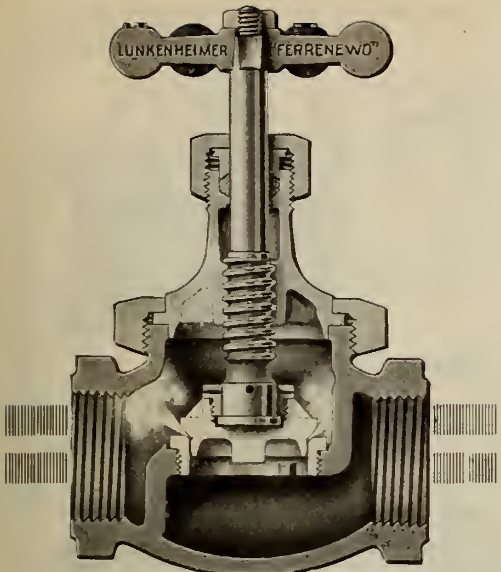
CO2 Indicator for Boiler Front

Let us hear from you. We are pioneers in the manufacture of Indicators and Recorders for Power Plant purposes.

Send for our Bulletin No. 110.

Uehling Instrument Company

2008 Empire Building New York City



"The reasons"

Why the LUNKENHEIMER "FERRENEWO" is the best iron body renewable seat valve made.

DESIGN: is original and practical. Union connection between body and hub (bronze to iron joint) with threads where steam cannot reach them, permits of easy access to interior for inspection or regrinding, and the renewal of any part, including the nickel seat ring and disc. Disc is provided with the well known Lunkenheimer "Seat-guard," which materially aids in preserving the seating faces and keeping them clean. Metal is uniformly distributed, giving maximum strength to all parts. Threads are long and cut perfectly true.

MATERIAL: Body is made of a **Special High Tensile Ferrous** Material, formulated in our own laboratories particularly for this valve, and is far superior in strength and durability to the grades of Cast Iron used by imitators. The **Seat Ring** and **Disc** are made of Lunkenheimer durable Nickle Alloy. Stem of Lunkenheimer high-tensile Bronze. Other trimmings of Lunkenheimer Steam Bronze and Handwheel of Malleable Iron.

WORKMANSHIP: is Lunkenheimer "Quality"—a standard unequalled.

Made in sizes ½ to 2 inches inclusive, for working steam pressures up to 150 pounds; Screw Ends only.

Specify and **insist** on having the genuine. Your local dealer can furnish them; if not write us. Write for booklet No. 567.

THE LUNKENHEIMER CO.
"QUALITY"
Largest Manufacturers of
High-Grade Engineering Specialties
in the World
CINCINNATI, O., U.S.A.
New York Chicago Boston London

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UNEQUALLED WORKMANSHIP
HIGHEST EFFICIENCY
COMPLETE SATISFACTION

ESCHER WYSS & CO.

WATER-WHEELS
GOVERNORS
TURBO-PUMPS
STEAM-TURBINES

WRITE FOR INFORMATION
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ESCHER WYSS & CO.
12 Coristine Bldg., Montreal

QUICK OPENING?

Well, Rather—A Quarter Turn Does the Trick and Full Pipe Opening Too!

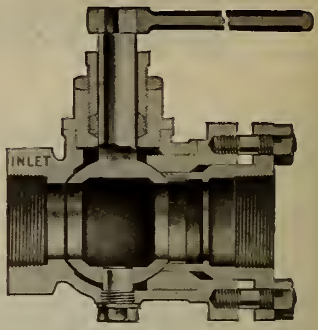
The seat is cleaned each time the valve is opened or closed.

Instead of becoming **LEAKIER** the valve becomes **TIGHTER**, if that were possible.

1,000 POUNDS HYDROSTATIC TEST.

300 POUNDS WORKING PRESSURE.

You get all this, and MORE, with THE HOWARD IMPROVED BALL VALVE.



Manufactured solely by

American Steam Gauge & Valve Mfg. Company

New York Chicago BOSTON Atlanta Pittsburgh

Selling Agents for Canada: CANADIAN FAIRBANKS-MORSE CO., LIMITED, Montreal, Toronto, Winnipeg, Calgary, St. John

ROTO TUBE CLEANERS

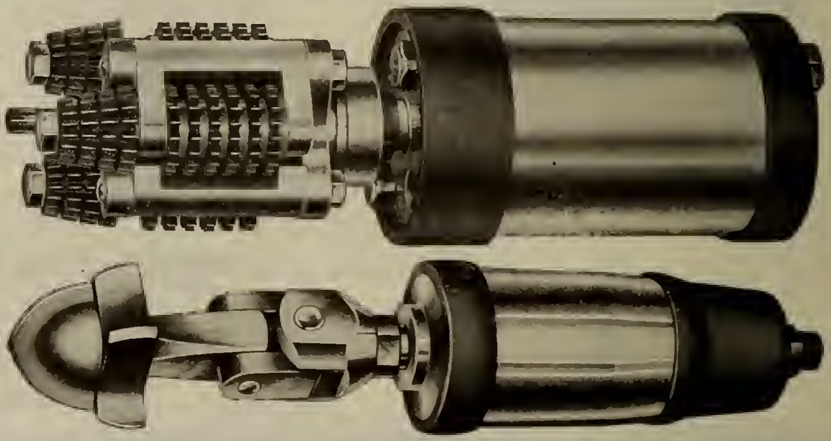
Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.

The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.

THE ROTO COMPANY

Write for Catalog HARTFORD, CONN.



You want Steam? Of course!

But you don't always get it, as much of it as you want, the instant you want it, and without smoke, dust, or grits.

If you don't it is because your boiler is not fitted with a "Bennis" Automatic Stoker.

"Bennis" Stokers stand for cheap steam and plenty of it, low coal bills, less labor, less wear and tear, less trouble, less worry. Why not investigate? That will cost you nothing and may save you £'s.

Write for our illustrated catalogs free on request.

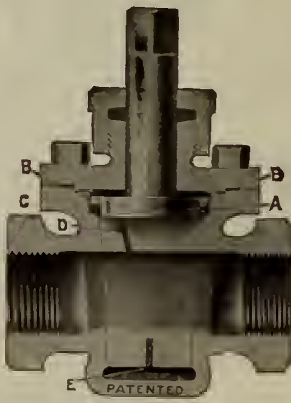
The G. H. Tod Co.

213 Manning Chambers
Toronto

601 Union Bank Bldg.
Winnipeg

"Homestead"

QUARTER TURN VALVES



Combine direct and unrestrained flow with simplicity and durability.

They are safe, reliable, tight and easy of operation.

Expert workmanship and the quantity and quality of material used in the manufacture of **Homestead Valves**, together with their practical utility and long wearing qualities, have brought insistent demands from all fields.

HOMESTEAD VALVE USERS INCLUDE THE LARGEST MILLS, MINES AND RAILROAD COMPANIES IN THE WORLD.

Homestead Valves are safe, reliable, tight and easy of operation. They eliminate the dangerous and distinctive pounding with a hammer to prevent leakage as in old style plug valves.

ONCE TRIED, ALWAYS USED.

A complete new descriptive catalog is just off the press and will be mailed upon request.

Homestead Valve Manufacturing Co.

PITTSBURGH, PA.

Works: Homestead, Pa.

JENKINS BROS.' VALVES

Have a Host of Imitators

Made in Canada

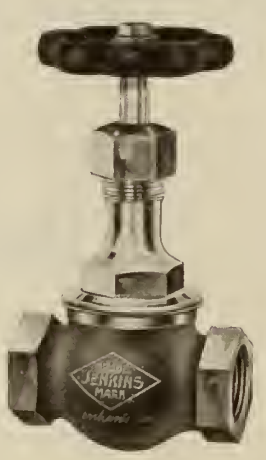


Fig. 106

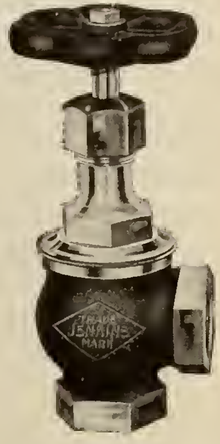


Fig. 108

It pays to insist upon getting the genuine. Because it is only with genuine Jenkins Bros.' Valves that you are sure of the service which has given these valves their reputation. The *appearance* of Jenkins Bros.' Valves can be copied, but the *service* goes only with the original.

We make a valve for every service.

Look for the Diamond trade mark before buying.

TRADE
JENKINS
MARK
Jenkins Bros.

JENKINS BROS.' VALVES are approved for use in Ontario and the Western Provinces by the Departments of Public Works.

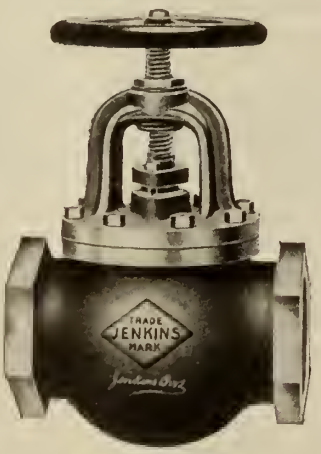


Fig. 141

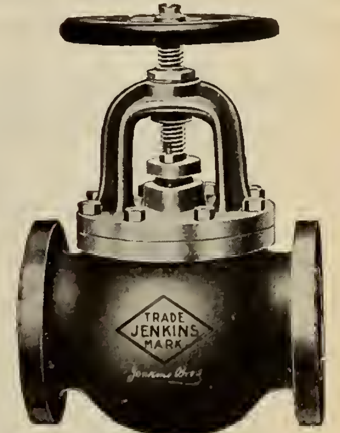


Fig. 142

The genuine JENKINS BROS.' VALVES are stocked by first class dealers everywhere.

Send for Catalogue 8.

TRADE JENKINS MARK Jenkins Bros. LIMITED TRADE JENKINS MARK
103 ST. REMI ST. MONTREAL

SCALE FORMATION—
BAGGING PLATES—
CORROSION OF BOILER
TUBES AND PLATES—
BURNT TUBE ENDS—
LEAKY SEAMS—
SHUT DOWNS—
DELAYS—
NIGHT AND
SUNDAY WORK
HAND CLEANING
OF SCALE FILLED
TUBES—
BLISTERS—
REPAIRS—
WORRY—
FUEL WASTE—

You Won't See a Thing You Like On That List!

On the other hand you'll see a lot of things you don't like—a lot of things you'd like to avoid in the future. Some of them you've come to look upon as unavoidable but there isn't a single one that can't be eliminated from your plant and from your boilers if you go about it right.

"Going about it right" means using

Dearborn Treatment

For by the Dearborn method most internal boiler troubles can be successfully overcome—certainly all the troubles we have listed here.

Send us gallon sample of your feed supply for analysis and let us advise definitely regarding your special needs.

Dearborn Chemical Company of Canada
LIMITED
General Offices, Laboratories and Works:
1220-30 Dundas Street TORONTO, ONT., CANADA

The Power House Tells You Why You Need a Dean

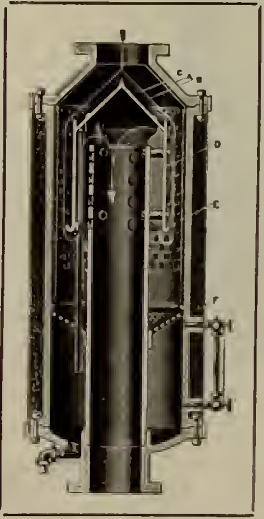
Question.—What is the effect of accumulation of scale and soot on the heating surfaces of a boiler?

Answer.—A coating of soot or scale, however thick or thin, is a bad conductor of heat, hence heat is prevented from getting as rapidly and as effectively to the water as it otherwise would were the plate surfaces clean, and to get the same amount of steam from the boiler in the former case, extra coal is needed to the following degree:—1/16 inch of scale necessitates 15 per cent. extra fuel; ⅛ inch of scale necessitates 32 per cent. extra fuel; ¼ inch of scale necessitates 66 per cent. extra fuel; ½ inch of scale necessitates 150 per cent. extra fuel.

The above question and answer appeared in the April issue of this paper, on Page 91, second column. It is an answer we have been giving for nearly 17 years. If you want efficient, economical fuel-burning boilers, you must periodically remove the scale—and, if you want **thorough** scale removal, you must use the Dean Boiler Tube Cleaner. Write us for "Scale Removal Made Easy"—which continues the story of the wastefulness of scale—and ask for details of our Free Trial Offer.

The William B. Pierce Co.
153 Ellicott St. 201-2 Coristine Bldg.
Buffalo, N. Y. Montreal, Quebec.
Winnipeg Representative: W. W. Hicks, 567 Banning Street

III IMPORTANT THINGS
TO CONSIDER ABOUT
A SEPARATOR.



I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

SWEET'S SEPARATORS.

DIRECT SEPARATOR COMPANY
820 Geddes Street - SYRACUSE, N. Y.

General Sales Agents:
Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Vancouver, Victoria.

Potato Scale Powder Boiler Cleanser

Makes and Keeps Boilers New in Efficiency and Economy

You cannot afford to let scale accumulate in your boilers because it reduces their efficiency, which means a larger amount of fuel is needed to produce desired steam pressure.

Your boilers will be clean all the time if you use a small quantity of Potato-Scale Powder in your feed water daily—there will be no foaming, pitting or any other troubles due to impurities in the feed water. **Potato Scale Powder Boiler Cleanser** is made to suit your feed water conditions, and contains nothing injurious to tubes or fittings.

Sold under a positive guarantee. **Try a barrel.**

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384. P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 977.

OVER 25,000 PROGRESSIVE ENGINEERS

ARE FIRM BELIEVERS IN

Its use has proved to them that it is a practical and economical way of getting rid of boiler scale troubles.

SEEING IS BELIEVING –

We'll send you a quantity on free trial. Use it and the scale already formed in your boilers will disappear and no new scale can form: your boilers will not have to be opened and washed out so often; they will not foam; your iron, packing, gaskets or lubrication will not be injured.

Perolin

MADE IN CANADA

Boiler Metal Treatment

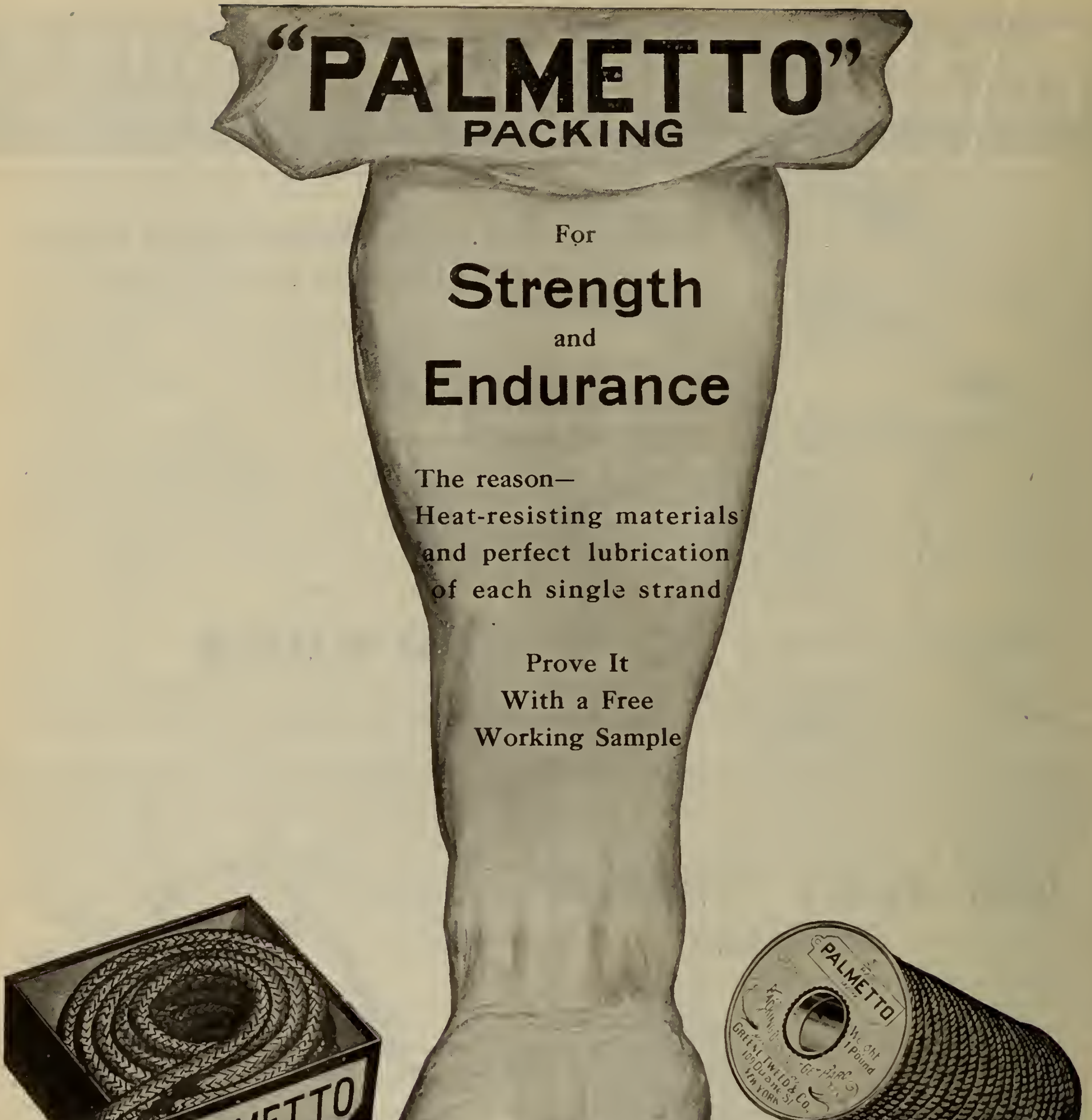
The efficiency of Perolin, "The Boiler Metal Preservative," is always at its highest point, because it does not treat the water—it treats the Boiler Metal and Boiler Metals are universally the same.

If you are interested in practical economy, you will be ready to let us demonstrate at our own expense what Perolin will do. Write us now.

PEROLIN COMPANY OF CANADA, LIMITED

Office and Factory: 858 Dupont Street, TORONTO, ONTARIO

WESTERN AGENTS: Canadian Sarco Engineering Co., Limited, 1206 McArthur Bldg., Winnipeg, Man. Western Supply & Equipment Co., Limited, Calgary, Alta. Bayfield & Archibald, 334 Seymour St., Vancouver, B.C.



"PALMETTO" PACKING

For

Strength
and
Endurance

The reason—
Heat-resisting materials
and perfect lubrication
of each single strand

Prove It
With a Free
Working Sample

GREENE, TWEED & CO.
SOLE MANUFACTURERS
109 Duane Street New York

CANADIAN DISTRIBUTING AGENTS:
The Canadian Fairbanks-Morse Co., Limited, Montreal, Ottawa, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Victoria, Vancouver.

"Repacking Your Engine To-night, Bill ?

"I know just how you feel, old boy, and I'll bet a nickel you wanted to go some place for the evening.

"Well, I don't want to make you sore, but you'll keep right on repacking your engine every week or so, like I did, until you take my advice and come around to P. P. P.; then, you'll forget all about stuffing-boxes for months, likely a year or two.

"Good luck and good night, Bill."

DANIEL'S ROD PACKING

P.P.P.

FOR STEAM, AIR, WATER, AMMONIA

Reg. U S. Pat. Off.

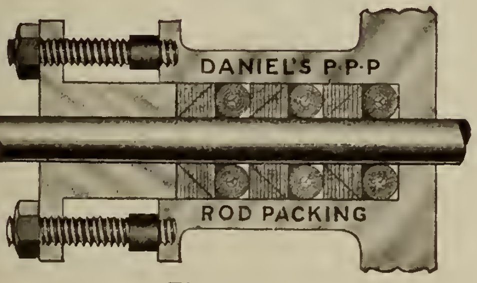


Fig. 3

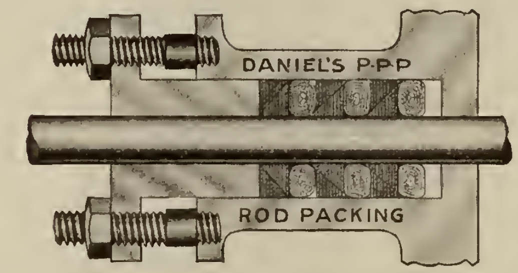


Fig. 4

Fig. 3 shows the normal position of "SPECIAL" P. P. P. in the stuffing-box of an engine of the ordinary high pressure type.

Fig. 4 illustrates the action of the packing under pressure and shows how the cushions compress and the wedges slide under pressure.

Special P. P. P. is for steam pressures above 100 pounds (when not superheated); *compound* condensing engines; *high ammonia pressures; high hydraulics; very hot water; air pumps, valve stems, etc.

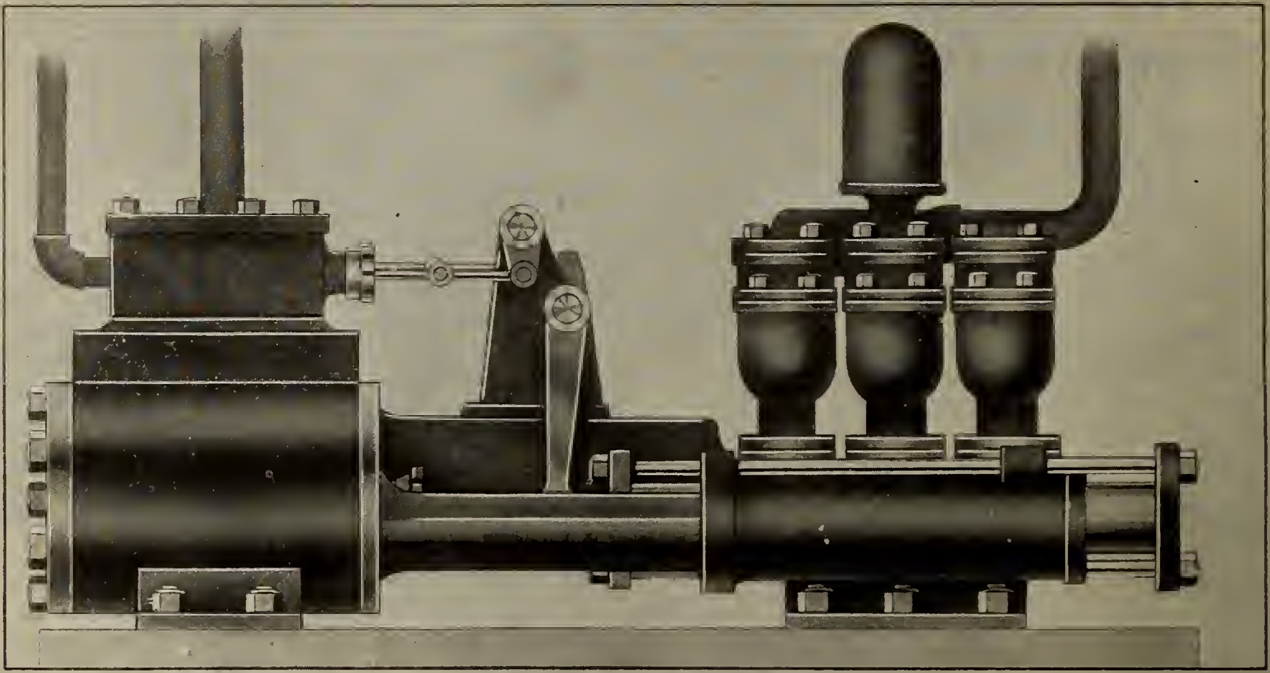
Special P. P. P. is not intended for use in *simple* high-pressure condensing engines.

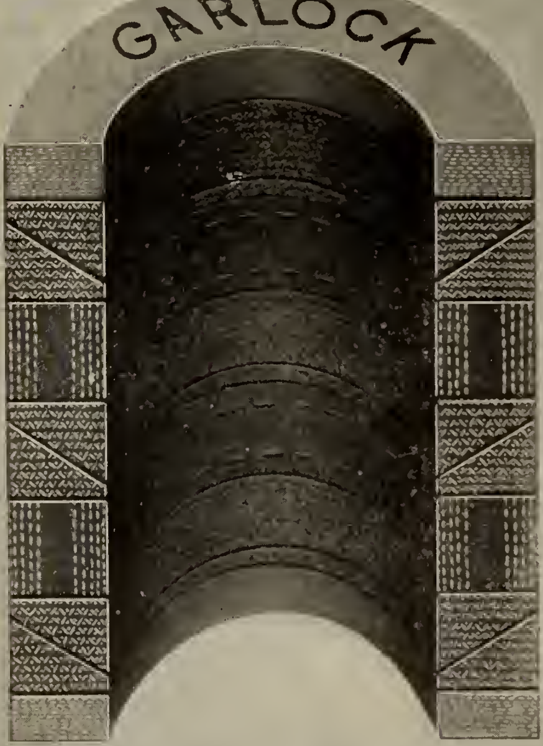
** P. P. P. for AMMONIA purposes is specially prepared; don't use the kind you do for engines, pumps, etc.*

Your dealer can supply you with the GENUINE Daniel's P. P. P. Rod Packing, but if he will not, then, write direct to the factory for the name of a nearby supply house that will give you what you want.

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS
PHILADELPHIA, PA., U.S.A.





Garlock 1907 Combination Packing

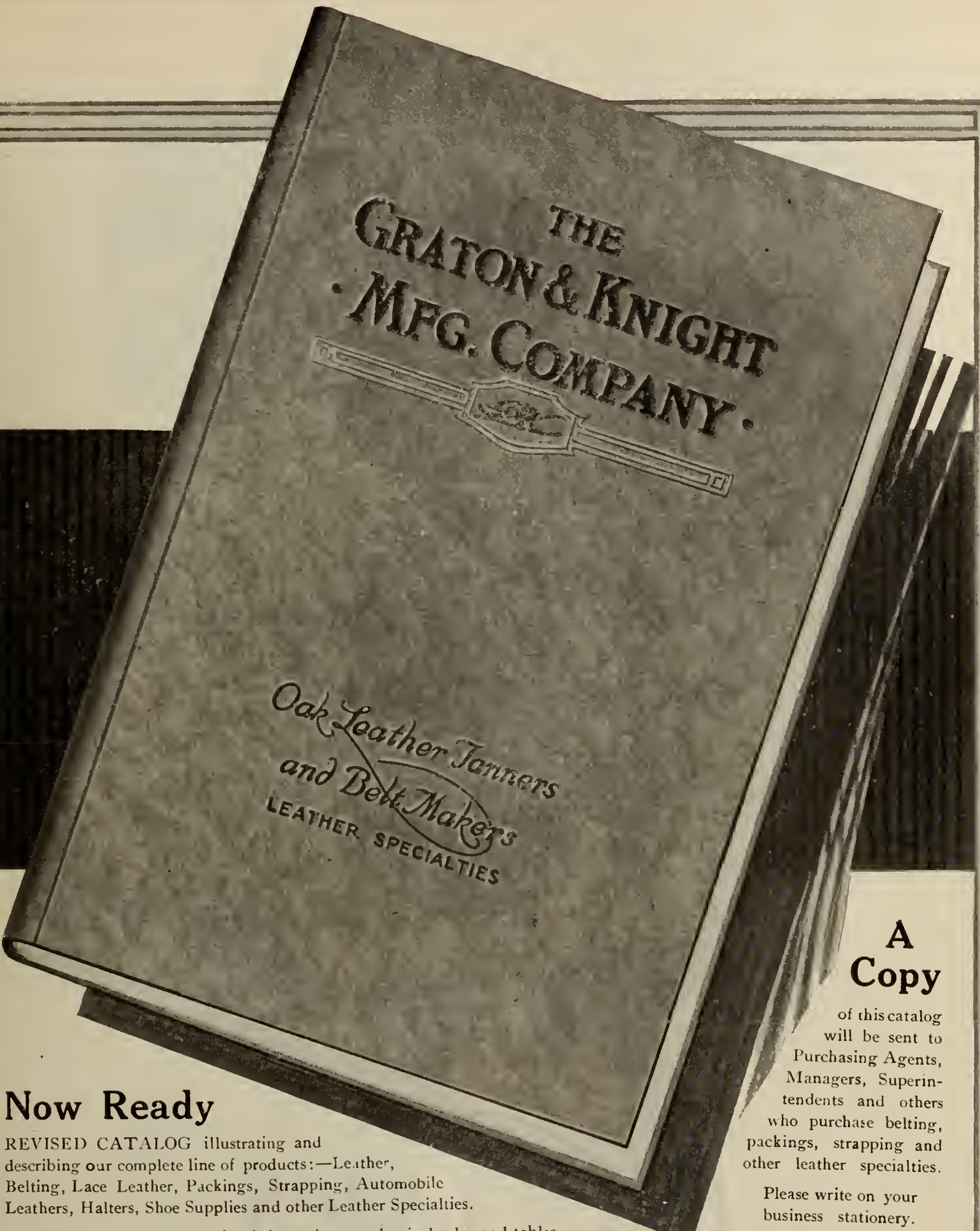
Especially adapted for outside packed plungers of pumps handling extremely hot water. It is composed of Garlock Special Hydraulic, Diagonal and Cushion Center Rings, which make it a strong and elastic packing, easy wearing on rods. There has been a long-felt want for packing that would give satisfactory service on hot water rods and outside packed plungers, and this combination is the best known packing for that service. A trial will convince you.

Write for catalog describing our many styles and combinations of packing.

The Garlock Packing Company, Hamilton, Ont.

BRANCHES:

Montreal, Quebec	342 St. James St.
Toronto, Ontario	404 Continental Life Building.
Winnipeg, Manitoba	Galt Building.



A Copy

of this catalog will be sent to Purchasing Agents, Managers, Superintendents and others who purchase belting, packings, strapping and other leather specialties.

Please write on your business stationery.

Now Ready

REVISED CATALOG illustrating and describing our complete line of products:—Leather Belting, Lace Leather, Packings, Strapping, Automobile Leathers, Halters, Shoe Supplies and other Leather Specialties.

Its many pages of useful belting information, mechanical rules and tables make this catalog particularly valuable to all buyers of belting equipment.

The Graton & Knight Manufacturing Company

Oak Leather Tanners and Belt Makers

Worcester, Mass., U.S.A.

Representatives in Canada:—The Canadian Fairbanks-Morse Company, Limited

St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.

The hides of the choicest steers, long experience and the Genuine British Oak Tanning Process stand behind every inch of

D. K. McLaren's Leather Belting

The use of this belting reduces slip to a minimum, thereby saving a considerable amount of power. Also saves a considerable amount of time, labor and attention, because there is practically no stretch.

The belt with extra life.

The toughness and durability of D. K. McLaren's Belting makes lasting qualities that are surprising.

Many of Canada's largest Industrial plants (firms that want the best of everything) are our steady customers.

Order your next belt from D. K. McLaren and you'll never buy elsewhere again.

GENUINE OAK

REGISTERED TRADE MARK

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LIMITED

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194 King St. West

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VANCOUVER, B.C.
847 Beatty St.

ENGINEERS SUPPLY CO., 123 Bannatyne Avenue East, Winnipeg, Man.

COST!

THE following is from a letter written to the American Wool & Cotton Reporter by W. F. Schaphorst, Woolworth Bldg., 233 Broadway, New York. It is published by permission.

The report of comparative tests of pulleys of different types for belt slip, made by H. M. Haven and Wm. W. Crosby, is in print and can be had on application.

"I read with much interest the 'Report of Engineers' Comparative Tests of Pulley for Belt Slip' by H. M. Haven and William W. Crosby, American Wool and Cotton Reporter, January 13, 1916 issue. I am much impresed by the enormous slip developed in the cast iron pulley, and wish to add something which the above engineers omitted. They do not say anything about 'cost of slip' in their report.

Since cost of slip is important I refer to their curve sheets No. 7, No. 8 and 9, which show the results of the whole series of tests in a nutshell.

On sheet No. 7, with a pull of 60 lbs. per inch width of belt, the American Steel Pulley shows a slip of 2.65 per cent. The cast iron pulley shows a slip of 5 per cent. under the same conditions.

5%—2.65%=2.35%

This means that if the drive is a 'main belt drive,' through which all power to the mill is transmitted, installation of the steel pulleys would represent a saving of 2.35 per cent. of the coal pile, for power loss is directly proportional to the slip. Where tensions are less the difference is less marked, but it is everywhere sufficient to show the value of the steel pulley as a fuel saver.

On Sheet No. 8, with a pull of 70 pounds per inch width of belt, the American Steel Pulley shows a slip of 1.8 per cent., whereas the cast iron pulley shows 4.5 per cent. slip.

4.5%—1.8%=2.7%

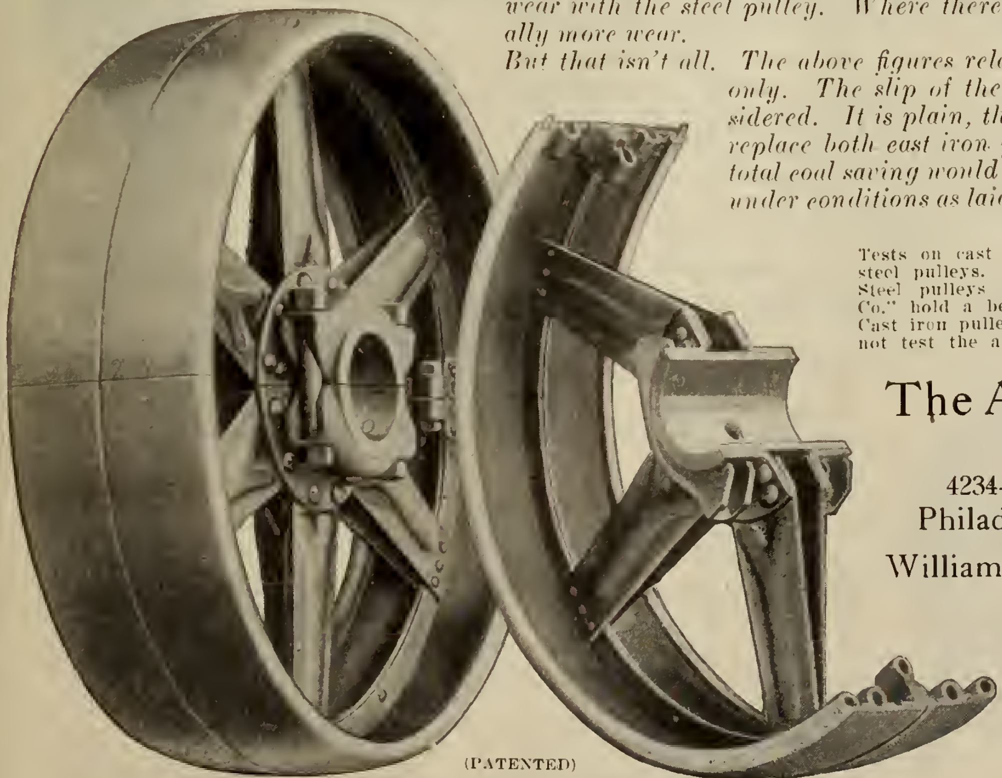
representing a saving of 2.7 per cent. of the coal pile.

On Sheet No. 9 at 106 pounds per inch width of belt the steel pulley shows a saving of 2 per cent. of the coal pile.

The best way to make this saving emphatic is to figure the cost of your coal per year and multiply by 2.35 per cent., 2.7 per cent. or 2 per cent., respectively.

If you spend $10,000 per year for coal the steel pulley would save $235 per year, letting alone the additional saving due to less belt wear with the steel pulley. Where there is more slip there is generally more wear.

But that isn't all. The above figures relate to the slip of one pulley only. The slip of the driving pulley wasn't considered. It is plain, then, that where steel pulleys replace both cast iron pulleys in a given drive the total coal saving would be pretty close to 5 per cent. under conditions as laid down in the above charts."



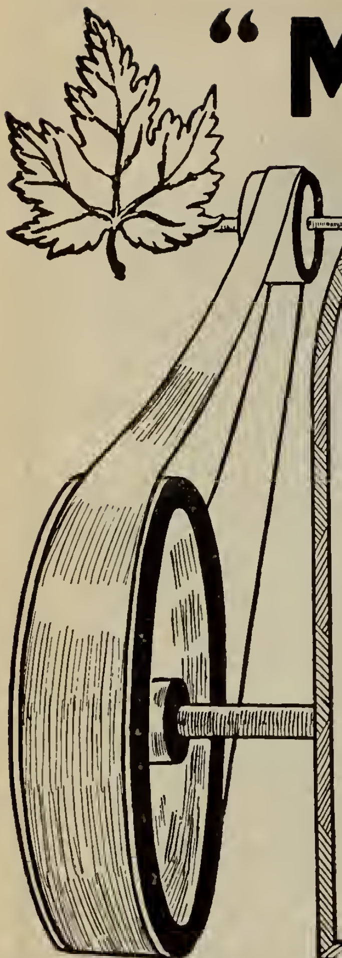
(PATENTED)

PLEASE NOTE

Tests on cast iron pulleys are no criterion for steel pulleys.
Steel pulleys made by "The American Pulley Co." hold a belt better than wood pulleys.
Cast iron pulleys do not hold a belt well. Why not test the above named steel pulleys?.

The American Pulley
Company
4234-60 Wissahickon Avenue
Philadelphia, Pa., U. S. A.

Williams & Wilson, Limited,
Montreal
The A. R. Williams
Machinery Co., Ltd.,
St. John, N.B.,
Toronto, Winnipeg,
Vancouver



"MAPLE LEAF"

Stitched Cotton Duck

Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.
A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for **FREE SAMPLE** and particulars.

MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless

Any Quantity sent
on APPROVAL

They Thought Two Would Do

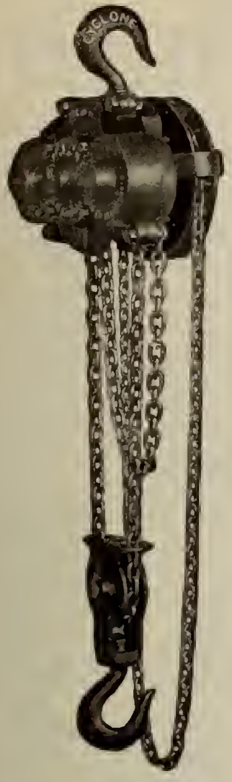
in a certain big New England mill, because mill and equipment were brand new and strictly modern.

But They've Bought Just 27 of These

Babbitt Adjustable Sprocket Rims

since July 1st. Like this: July 1, two; July 20, two; July 23, six; Aug. 25, eight; Sept. 8, nine. That's the way they go, because everybody recognizes them on sight, as "Just the thing they have been looking for, but did not know where to get it." Easy to put on—goes right on your present valve wheel—easy to pay for. Ask your dealer. Send for Illustrated folder.

Babbitt Steam Specialty Co., 59 So. Water St., **New Bedford, Mass.**



5 Ton "Cyclone"
Chain Hoist

Chisholm-Moore "Cyclone" High-Speed Chain Hoists

with self-lubricating graphite-bronze bearings and patented Frictionless Reducing Gear, show a remarkably high efficiency, averaging 80% over the whole range of sizes. The peculiar gyrating movement in the reducing gear, and the use of accurately cut gears throughout, make possible a very high speed with light hand chain pull and practically no vibration.

Chisholm-Moore hoisting equipment, including "Cyclone" Chain Hoists, "Matchless" Trolleys and Hand Travelling Cranes, is made to fit every purpose, and ranges in size from ½ to 40 tons capacity.

Write for Catalogue to

Lyman Tube & Supply Company, Limited

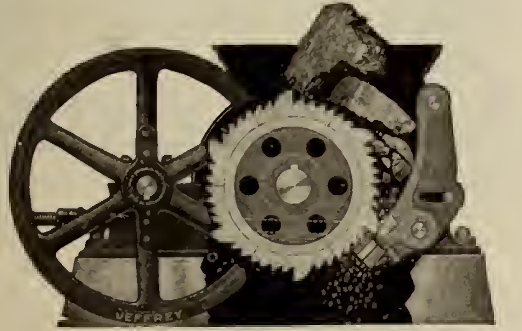
MONTREAL
323 St. James Street

TORONTO
33 Melinda Street

The One Indispensable Instrument in Your Fine Coal Problem

IS THE

Jeffrey SINGLE ROLL Crusher



Some Important Features :

Reduces Run-of-Mine Coal to ¾" or 1", in a single operation.
Safety device protects against foreign materials.
Is cushioned against sudden shocks.
Is adjustable to make different products without any change of equipment.
Has renewable bronzed bushings in the bearings.
Has renewable segments and teeth.
Cannot be stalled under load.

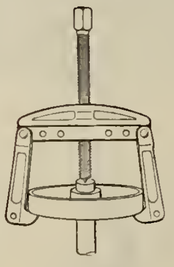
Ask for Bulletin No. 141-4, with complete details.

The Jeffrey Manufacturing Co.

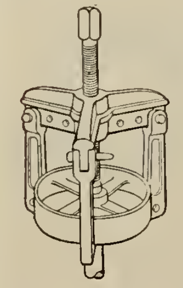
Canadian Branch and Warerooms, Montreal

Crane's New Model

Patent Wheel Puller



Removing Work
Near End of Shaft



Three Arm Puller

For Removing

Transmission and Cam Shaft Gears, Auto Wheels, Fly-Wheels, Sprockets, Collars, Couplings, Propellers, Universal Joints—for Straightening Shaft, Bending Pipe, etc.

The screw has a flat end with inserted tempered tool steel point, that will not spread cutters. Makes its own centre on work that has none. The strain is taken on the flat end of the screw. Grease to keep from cutting. The screws are made of high carbon steel and case-hardened all over. All pullers are furnished with two sets of the new combination hook extension arms.

No. 2 Puller will reach work 11" from end of shaft and 16" in diameter.

No. 3 Puller will reach work 13" from end of shaft and 20" in diameter.

We also furnish a 9" arm for the No. 2 Puller, a 10" hook and a 10" extension arm for the No. 3 Puller.

Both the No. 2 and No. 3 Pullers are made in the two arm and three arm styles.

We absolutely guarantee the workmanship and material in our tools.

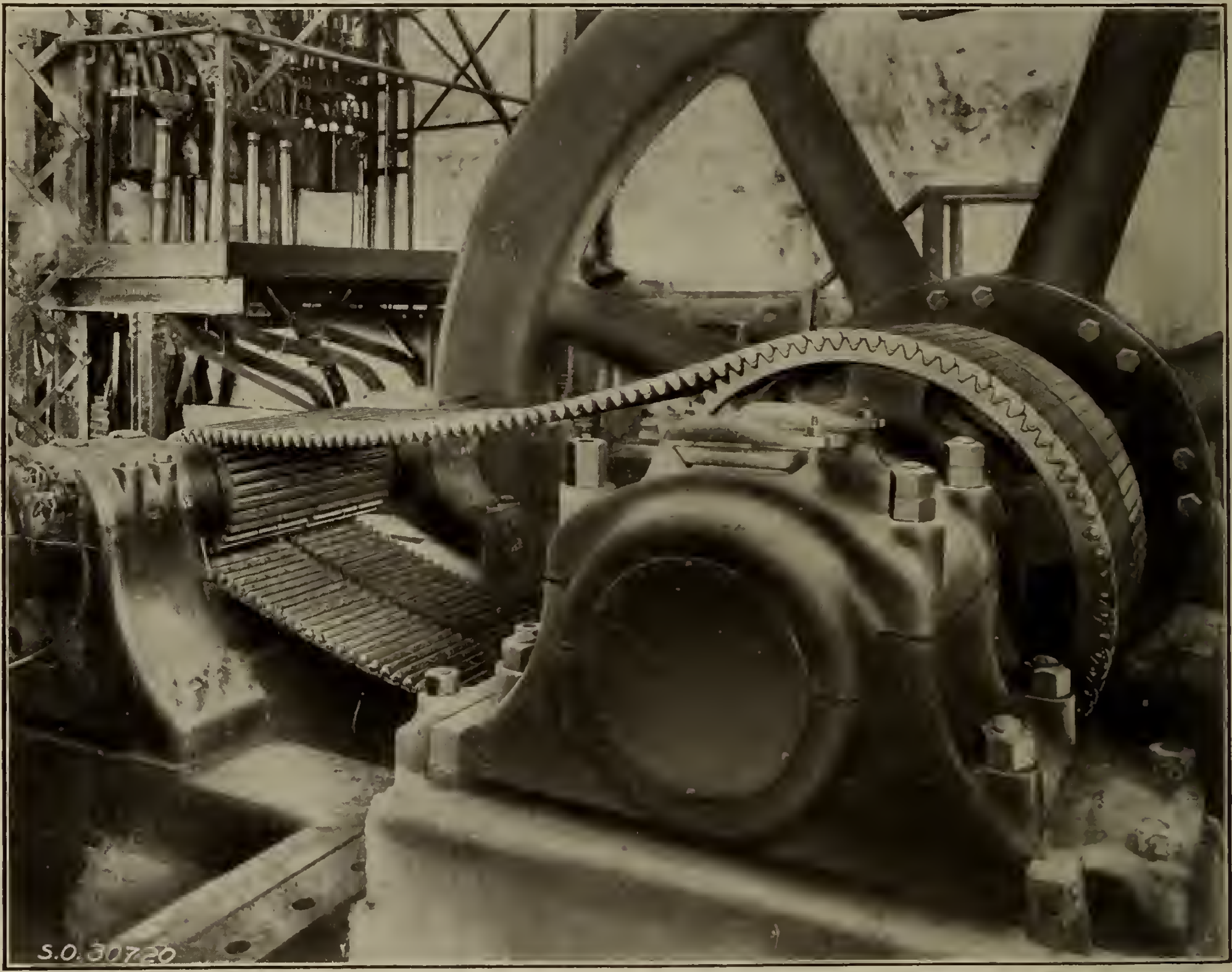
THE CRANE PULLER COMPANY

54 Lake Street, ARLINGTON, MASS., U.S.A.

Canadian Distributors: Canadian Fairbanks-Morse Co., Montreal, Toronto, Vancouver, Winnipeg, St. John, Calgary; John Millen & Son, Montreal, Toronto, Winnipeg, Vancouver

If any advertisement interests you, tear it out now and place with letters to be answered.

What Make of Chain?



600 H.P. Silent Chain Drive from electric motor to 18" Merchant Mill Rolls.

"MORSE"—Of Course

You can save time by addressing our nearest office

New York ....50 Church St.
Boston ....141 Milk St.
Chicago ....Merchants L. & T. Bldg.
Pittsburgh ....Westinghouse Bldg.
Cleveland ....421 Engineers Bldg.
Detroit ....1003 Woodward Ave.
San Francisco ....Monadnock Bldg.
St. Louis, Morse Engineering Co.....Chemical Bldg.
Kansas City, Morse Engineering Co., R. A. Long Bldg.
Minneapolis, Strong-Scott Mfg. Co.
413 Third St., South
Atlanta, Earl F. Scott, M. E.......702 Candler Bldg.
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Licensees for Europe: The Westinghouse-Brake Co., Ltd., 32 York Road, King's Cross, London, N.

MORSE CHAIN CO.

Gentlemen:

Please send a copy of your Publication No. 14 to the address given below. Also name preliminary proposition for a MORSE Silent Chain Drive as per the following specifications:

Maximum hp. to be transmitted..

Drive from ....to........................

R.P.M. of driver ....Of driven ....

Distance between shaft centers ....inches

Daily use desired of about ....hours

Name of individual ....

Company ....

Address ....

Power House, June, 1916.

Starrett Yankee Micrometer No. 650

Without Ratchet Stop
$4.00

With Ratchet Stop
$4.50

FOR measurements by thousandths up to one inch. Has improved Speeded Screw and means for adjusting to compensate for wear.

The frame is made of drop forged steel, nickel-plated, dull finish. Sleeve and thimble are slightly smaller in diameter than our No. 3 Micrometer. Frame and sleeve one piece. A light, strong and rigid Micrometer.

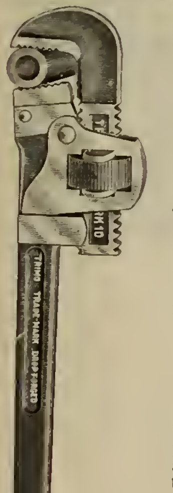
2100 *styles and sizes of Starrett Tools*

Write for Free Catalog No. 21 C.D.

The L. S. Starrett Company
"The World's Greatest Tool Makers"
Athol, Mass.
London New York Chicago

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH



Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

The Nut-Guards prevent the accidental rotation of the nut while in use.

These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.

Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union
Roxbury (Boston) Mass., U.S.A.

Where a Few Cents' Worth of Cling-Surface Saved Many Dollars

> *"It is but just that we state our success with Cling-Surface. Before its use, we seriously contemplated buying a new engine, because we did not have enough power to run our drop-hammer. After lengthening our belts and applying Cling-Surface, however, we obtained more than enough power to run our hammer and all our other machinery besides."—Wm. Didier Mfg. Co., Racine, Wis.*

Whether your plant is large or small, the direct benefits from Cling-Surface treatment would be proportionately great enough to more than pay its way.

And now that Cling-Surface, in its new fluid form, requires no preliminary heating at ordinary temperatures, greater convenience of application adds another inducement to take advantage of its preservative and power-saving qualities.

Send us a trial order for a working package, or at least ask for our literature.

We quote f.o.b. Toronto.

Cling-Surface the life preserver for belts

Cling-Surface Co
1057 Niagara Street
Buffalo NY

I am interested in Cling-Surface and your trial order proposition.

Name ....Position...............

Firm ....

Street ....

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83

TRADE MARK

TRADE MARK

TWO SATISFIED USERS

154 Fourth St.,
Union Course, L. I.,
March 15, 1915.

Gentlemen:—

The writer can say that Magnolia Metal has given him the greatest satisfaction for bushings, bearings, crosshead shoes, and guides.

For long wear, high speed and freedom from trouble from grit it cannot be beat.

Yours truly,
A. L. Bennett.

Portland, Ore.,
August 18, 1915.

Gentlemen:—

Three years while Chief Engineer for the Luna Lead Smelting Co., we used Magnolia Metal for everything and found it to be without equal for bearings—main and crank—lay shafts, etc., etc., on internal combustion oil engines.

Have also found Magnolia Metal to be satisfactory in every respect on other types of prime movers and use nothing else.

Yours respectfully,
W. W. Coons.

PRACTICAL ENGINEER POCKET BOOK:

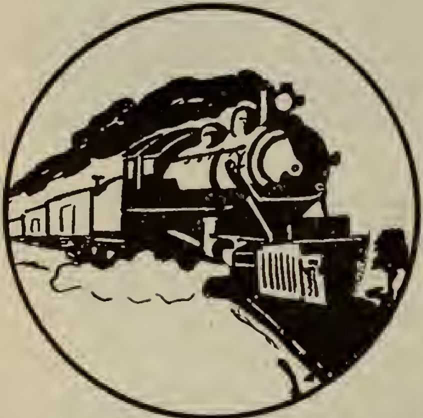
Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c. post paid.

Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

OFFICE AND FACTORY:
225 St. Ambroise St. MONTREAL



Sliptivity Steam Cylinder
Sliptivity Steam Engine
Automobile Cylinder

OILS

These highly efficient lubricants go a long way and will greatly add to the life of your machinery.

They are a triple combination that's hard to equal. A trial will convince you of this fact and create a desire for more.

USED OVER THE ENTIRE WORLD.

Our prices are very reasonable for that of good quality.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384, P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 877.

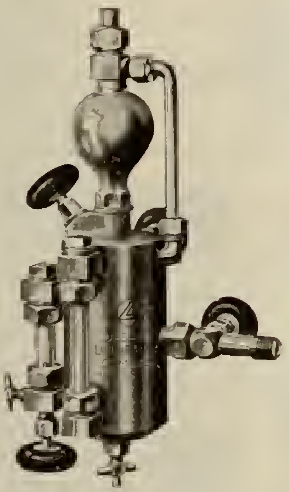
Detroit Lubricators

Give

Constant, Even Temperature and Rate of Feed

The cored heating passage, cast with the body and lending strength to same, is filled with steam while in operation. The heat keeps oil in a thoroughly liquid condition, making it possible to feed heavy oils. The temperature maintained is even and there is therefore no fluctuation in the rate of feed. Easy filling without waste and delay resulting from bubbling is another feature. Write for our catalog. Sent on request.

Look for our Trade Mark when in the buying mood.



Efficiency
Holds
Over Half
The World's Trade

Makers of the Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

ALBANY GREASE

will show wonderful lubricating results on engines, motors, pumps, compressors, line shafting and all other kinds of machinery at all times. Albany Grease can be used in any kind or style of grease cup and will not cake or clog the cup. It will not leak or run away. No matter what kind of machinery you have, Albany Grease will lubricate it perfectly. Why not try Albany Grease at our expense? We'll send a quantity and a cup if you will write.

Your dealer sells Albany Grease; if not, order direct

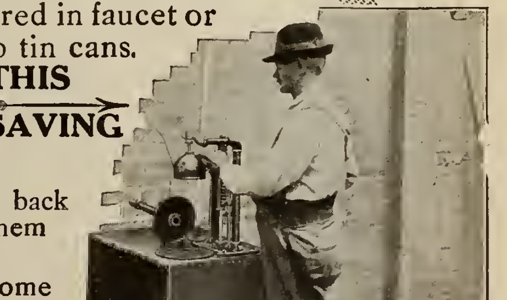
Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868

Which is yours?

THIS
WASTE
and fire hazzard go hand in hand where the oil is slopped around "any old way."

Handling your liquid money (oil) in any old way just because it is oil, or putting it in a safe like the real money it is? On the left is not an exaggerated picture of what daily happens in a power plant where oil is stored in faucet or "jigger" pump tin cans.

THIS
SAVING



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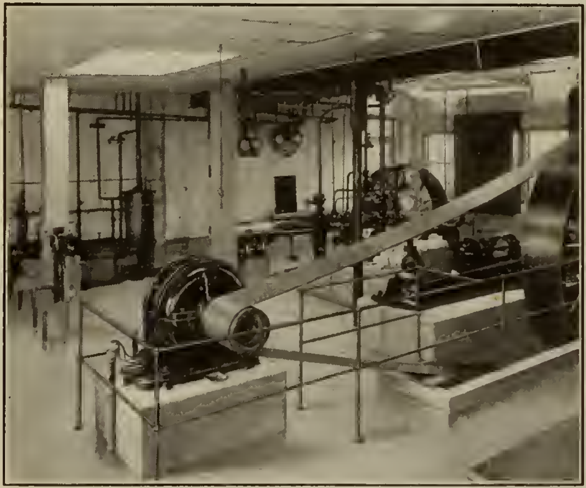
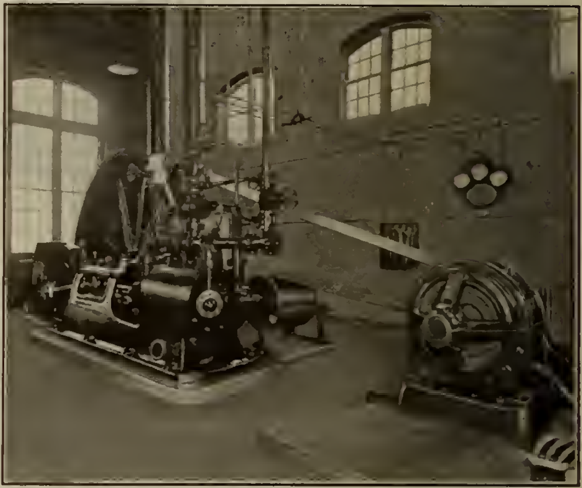


LINDE



REFRIGERATING AND ICE-MAKING MACHINERY

If you need certain refrigeration, the kind that meets extreme as well as ordinary conditions

ASK OUR ENGINEERS.

The Linde Canadian Refrigeration Company, Limited

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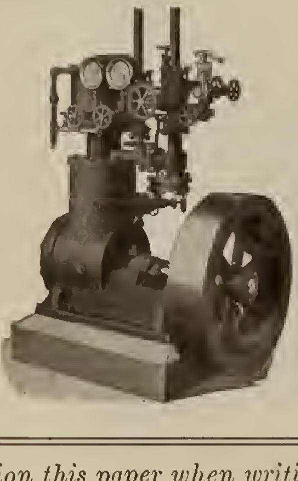
Makers of Quality Machinery in Canada since 1896.



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Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones. AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Corliss Engines *Special Machinery*

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"Reports from practically all sections of the country declare that the ice harvest has been most unsatisfactory."
(Editorial)

But this is not news. The *Natural* ice harvest is never satisfactory.

MECHANICAL
REFRIGERATION

is always satisfactory, if installed the YORK way.

Then why continue using ice for cooling, when Mechanical Refrigeration is less expensive, more dependable, more sanitary and more satisfactory in every way? Be independent of the ice harvest.

We have a Branch Office near you, supervised by expert engineers, who will be glad to give you information and prices on a Refrigerating Plant best suited to your individual requirements. Shall we have them call?

York Manufacturing Company
(Ice-Making and Refrigerating Machinery exclusively)
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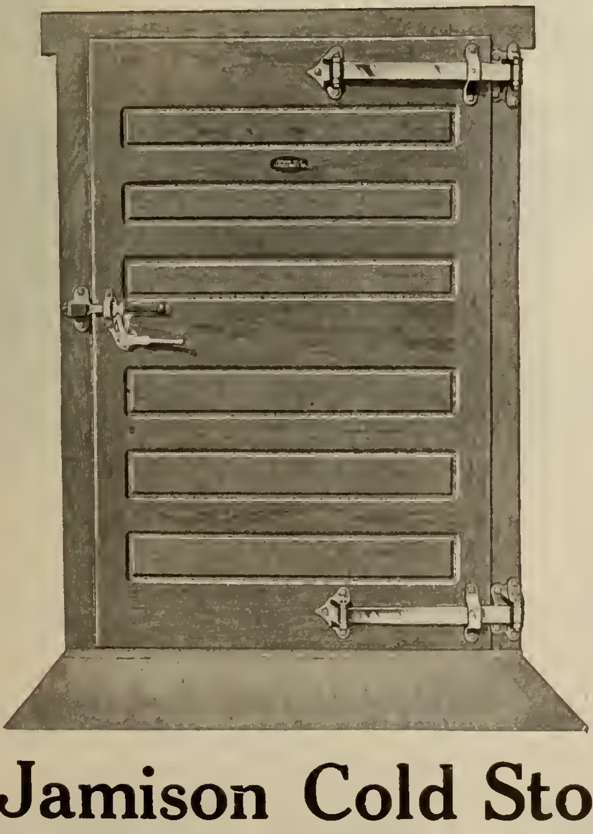


DOORS

For Cold Storage and Freezer Purposes Either Standard or Fireproof

JAMISON'S "JONES" and "NOEQUAL" doors are SUPERIOR because:

1st—Only the best materials are used in their construction.
2nd—We use heavier materials. Result: Longer life and increased efficiency.
3rd—Our doors are built with double and triple seals of contact—others have but one.
4th—Our Automatic Self-Tightening Fastener is the only truly AUTOMATIC and SELF-TIGHTENING Fastener on the market.
5th—Our ADJUSTABLE SPRING Hinges mean the door is always properly seated in the frame, making sagging impossible.

Write for General Catalog No. 7, illustrating and describing both "Jones" and "Noequal" doors, windows, ice doors and chutes, etc.

Jamison Cold Storage Door Company
Formerly Jones Cold Store Door Co. HAGERSTOWN, MD., U.S.A.

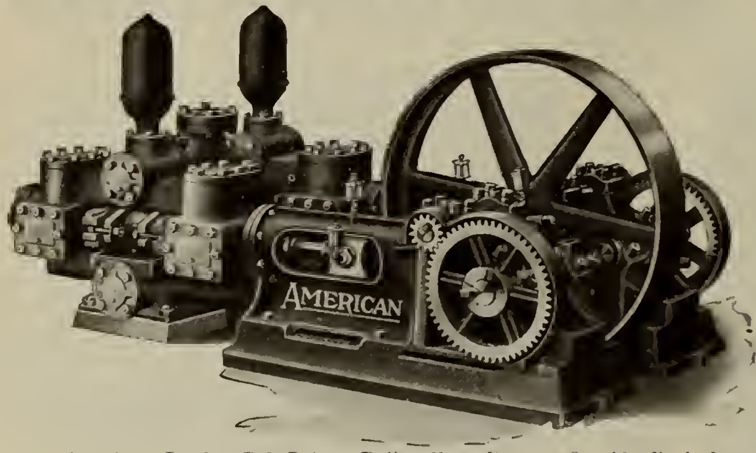
If any advertisement interests you, tear it out now and place with letters to be answered.

MARSH and AMERICAN

Pumping Machinery. Steam and Power Driven

The world has used and endorsed over 130,000 Marsh and American Pumps. Twenty-seven years of pump manufacture have proved our ability and perfected our facilities. Marsh and American Pumps are 100 per cent. correct—from the selection of raw material and accuracy of design to the actual pumping service, day in and day out, year after year. They ask no apologies and never have to explain away any error in service or failure in efficiency.

Investigate. Ask for our 250-page catalog illustrating and describing the line. Your pumping problems will be answered fully and satisfactorily through this investigation. This catalog will be sent by return mail in answer to your inquiry. Your copy is awaiting your prompt request.



American Duplex Belt-Driven Boiler Feed Pump. Outside Packed Plunger Pattern.

AMERICAN STEAM PUMP COMPANY

BATTLE CREEK, MICH.

CANADIAN AGENTS:

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary
Taylor Engineering Co., Ltd., Vancouver, B.C.

Lost---The Income from $3,000 at 6%

One Hundred and Eighty Dollars ($180.00) per year—the income on $3,000 at 6%—is the loss which results from the waste of one ton of refrigeration per day, even at the low cost of 50 cents per ton. And it takes only a comparatively small amount of bare cold piping to cause that loss.

Now, by using the proper thickness of

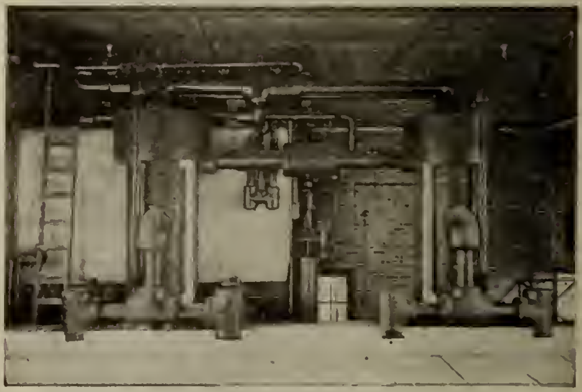
Nonpareil Cork Covering

For All Cold Pipes

at least 80 per cent. of this loss can be stopped, which means a saving of $144.00 per year. Can you afford to leave your pipes uncovered?

Nonpareil Cork Covering has all the necessary qualities of a perfectly satisfactory insulation for cold pipes. It is an excellent nonconductor of heat, very durable under the hardest service conditions, neat and trim in appearance and easy to apply. Furthermore, Nonpareil Cork Covering is reasonable in cost, and as an investment it will pay a return of over 100 per cent. per year.

Full information is given in the 64-page book entitled, "Nonpareil Cork Covering," which will be sent —free of charge—on request.

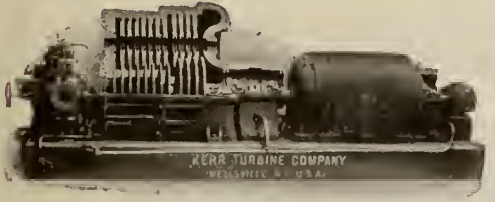


Brine and ammonia lines and ammonia accumulators insulated with Nonpareil Cork Covering. Alpine Ice Company, North Kansas City, Mo.

Armstrong Cork & Insulation Co., Limited, 504 McGill Building, MONTREAL, QUE.

Also manufacturers of Nonpareil Corkboard for Cold Storage rooms and Nonpareil High Pressure Covering for steam lines.

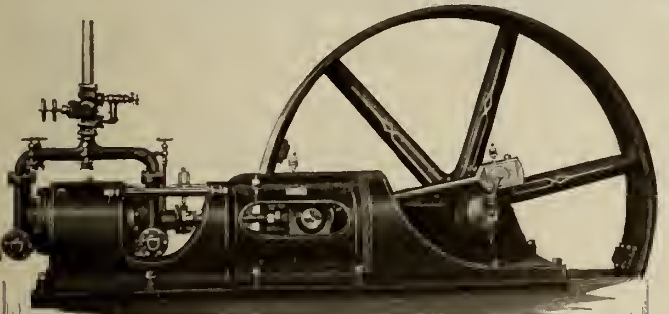
'KERR ECONOMY' Steam Turbines



Accessibility. Note the above photo, which shows a 500 K.W. "Kerr Economy" Turbo Generator with horizontally split turbine casing raised to show discs and rotor and accessibility of parts. Note that the discs are completely exposed down to the shaft.

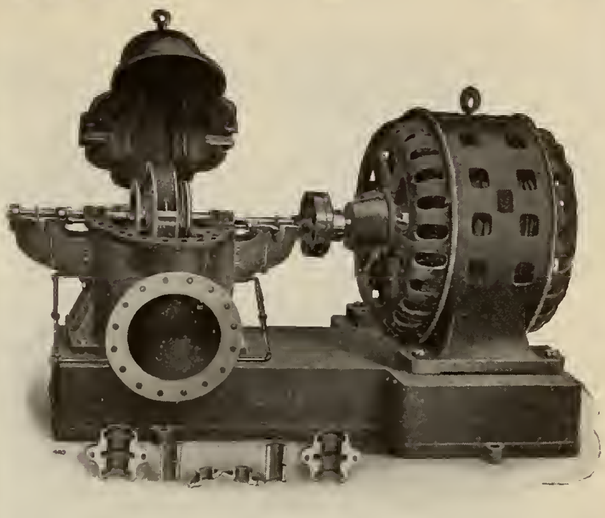
Adaptability. The production of highly accurate and quiet operating "Kerr Economy" Herringbone reduction gears has greatly broadened the field of the "Kerr Economy" Steam Turbine, permitting turbines to operate at most economical speeds while driving low speed machines. They explain our many very successful geared turbines supplying power for rope or belt drive pumps, low speed generators, etc. A number of our turbines are now used to drive large reciprocating pumps through 75 to 1 double reduction gears.

KERR TURBINE COMPANY
WELLSVILLE NEW YORK, U.S.A.
Offices in Montreal, Toronto, Vancouver, Winnipeg and all large cities in the United States



When you are in the market for a high-class ice-making or refrigerating plant, do not overlook the service and equipment which we have to offer. It is worth your careful investigation. *Your inquiry will be appreciated.*

THE HUETTEMAN & CRAMER COMPANY
Manufacturers of
Ice-Making and Refrigerating Machinery
DETROIT, 43rd Year. MICHIGAN, U.S.A.



The Modern High Efficiency

Centrifugal Pump

WAS introduced into the United States in 1901 by the De Laval Steam Turbine Co., which has specialized in its design and manufacture for all heads and capacities.

All De Laval Centrifugal Pumps are guaranteed as to duty and capacity, and a comprehensive test is run *before* the pump is shipped.

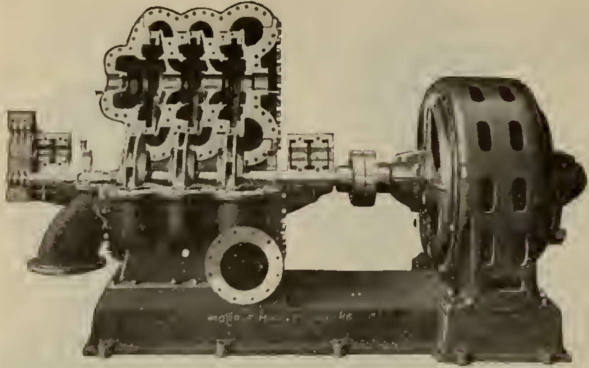
Every De Laval pump is built to limit gages and parts can be ordered by telegram giving the symbol numbers stamped thereon.

De Laval apparatus has a deserved reputation for high-class work and good engineering.

Ask for our 300-page book B-61 on "Characteristics, Selection, Design, Manufacture and Uses of Centrifugal Pumps."

DE LAVAL
Reg. U.S. Pat. Office
Steam Turbine Company
Trenton, New Jersey

TURBINE EQUIPMENT CO., LIMITED
Canadian Pacific Building TORONTO, Canada
THE E. LAURIE CO,
243 Bleury Street 215 **MONTREAL, Que.**



Reliable Pumps

When you buy a machine of any kind, you ought to take into consideration the maker's reputation and experience.

"Morris" Pumps have been manufactured for half a century and embody experience and careful workmanship with the most up-to-date practice in pump design.

The cut shows a horizontally split shell multi-stage pump with top half of shell raised for inspecting the interior. necessitating no breaking of pipe connections—altogether a most simple operation to get into it. We have a pump for every service.

STOREY PUMP & EQUIPMENT CO., KENT BUILDING TORONTO, CAN.

Canadian Sales Agents for

MORRIS MACHINE WORKS, BALDWINSVILLE, N.Y.

Many Shops are Cramped for Space

ONLY three days' work a month is sufficient to make this machine show a profit over hand pipe-threading.

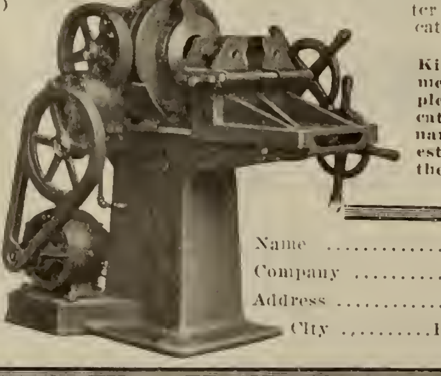
Besides that. it transforms your pile of scrap-pipe into money by threading it into nipples in its spare time.

Straight pipe, bent pipe, bolts and nipples—even close nipples—all come out of this machine easily and accurately threaded—ready for quick fiting into tight, accurate joints.

OSTER

No. 304 A
(1" to 4")

One man and this machine can beat a gang threading with hand tools. And note the small floor space required. Made in 3 sizes. Better write for catalog.



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**THE
OSTER
MFG. CO.**
2099 E. 61st
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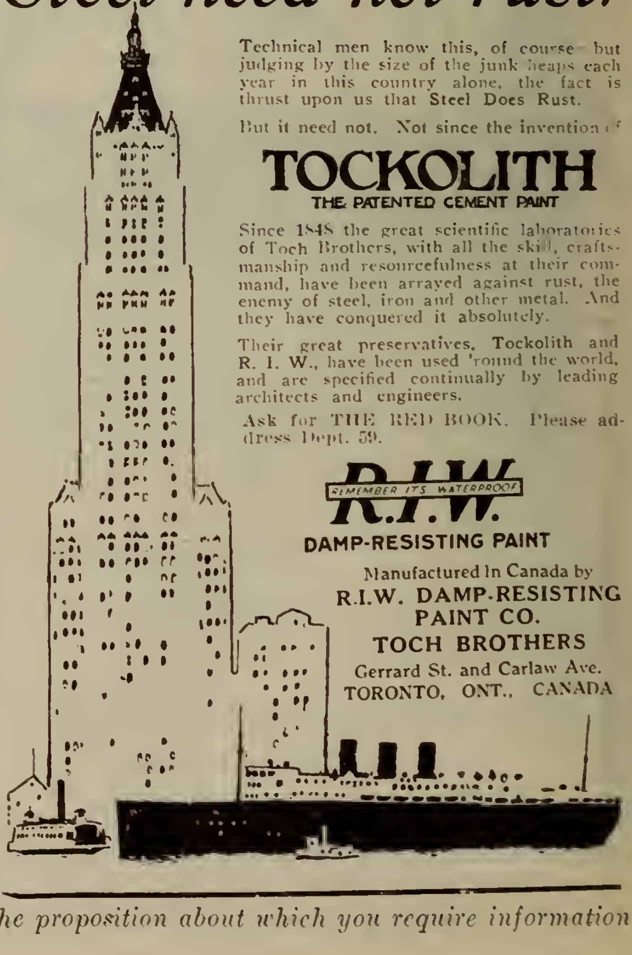
Steel need not rust!



Technical men know this, of course but judging by the size of the junk heaps each year in this country alone, the fact is thrust upon us that Steel Does Rust.

But it need not. Not since the invention of

TOCKOLITH
THE PATENTED CEMENT PAINT

Since 1848 the great scientific laboratories of Toch Brothers, with all the skill, craftsmanship and resourcefulness at their command, have been arrayed against rust, the enemy of steel, iron and other metal. And they have conquered it absolutely.

Their great preservatives, Tockolith and R. I. W., have been used 'round the world, and are specified continually by leading architects and engineers.

Ask for THE RED BOOK. Please address Dept. 59.

R.I.W.
REMEMBER ITS WATERPROOF
DAMP-RESISTING PAINT

Manufactured in Canada by
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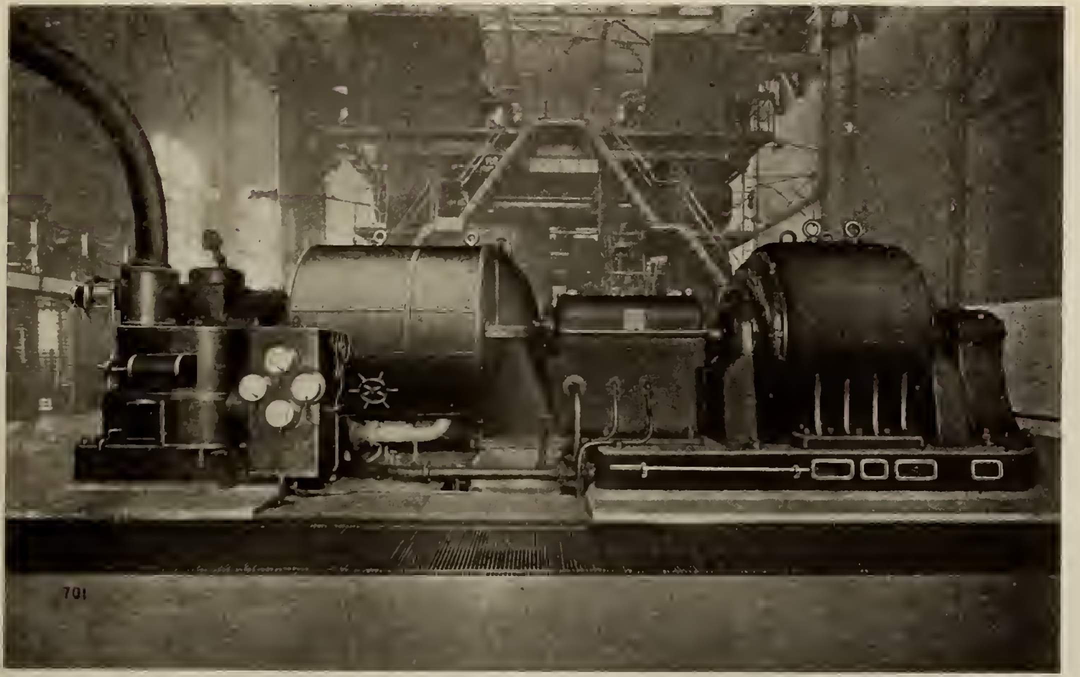
BELLISS & MORCOM, LTD.
Engines and Air Compressors



MONTREAL TRAMWAYS, HOCHELAGA PLANT
2,500 Kilowatt Belliss & Morcom Steam Turbine

We have for immediate delivery several Belliss & Morcom Engine Generator Sets. Write for particulars.

Send Us Your Enquiries For

CENTRIFUGAL PUMPS

Steam Engines, Boiler Feed Pumps, Condensing Plants, Producer Gas Engines, Air Compressors, Oil Engines, Steam Turbines, V-notch Water Meters.

Complete Power Plant Equipment.

We can offer a large assortment of machinery for immediate shipment

LAURIE & LAMB

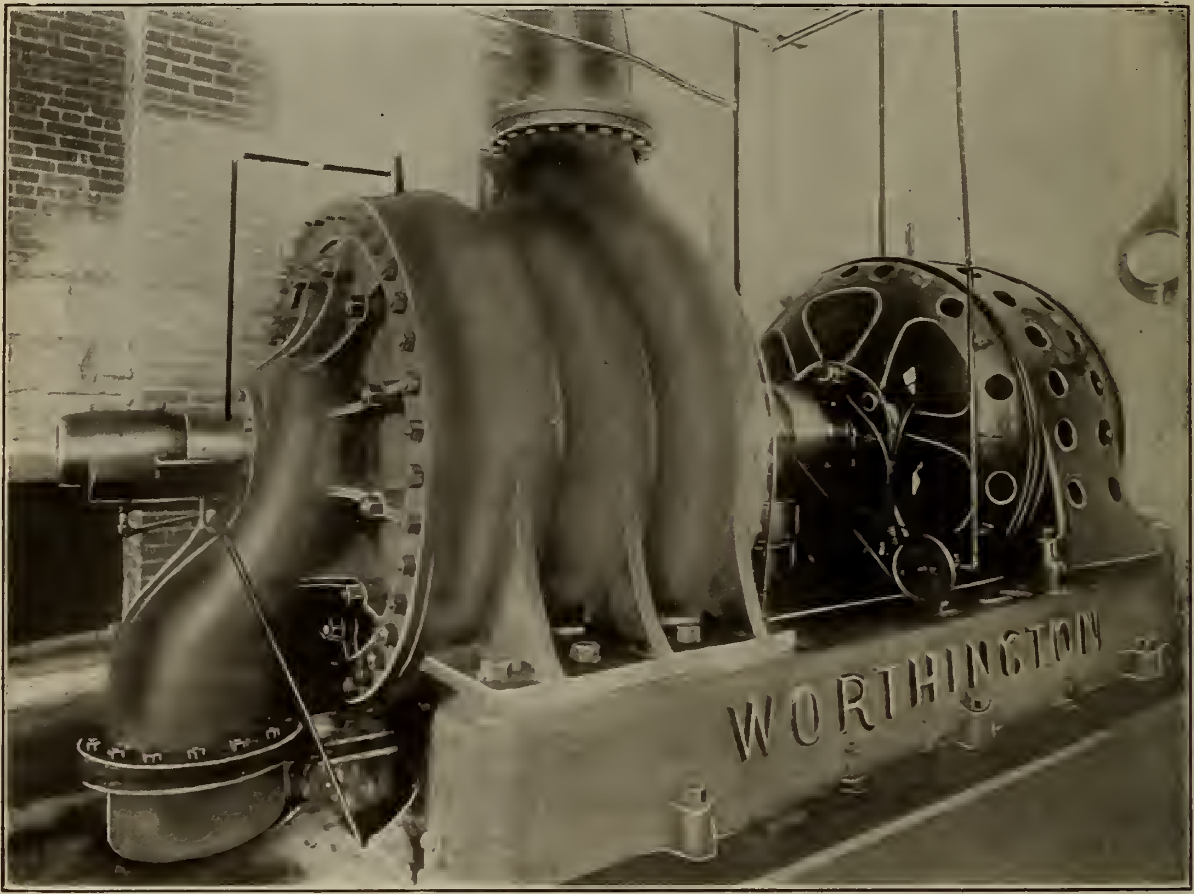
Engineers

211 Board of Trade Bldg. :-: :-: MONTREAL

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps—centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works: Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment of their Boiler, Feed and General Service Pumps

The Publisher's Page

Next Month's Power House

THE 27th Annual Convention of the Canadian Association of Stationary Engineers will be held in Montreal, July 25-27.

The July issue of The Power House is to be our pre-Convention Number.

The Montreal Technical School has been secured for the meetings of the Association delegates and for the exhibits of power equipment and supplies which, under the auspices of the Exhibition Association, is held in connection with the Annual Convention of the C.A.S.E.

No more suitable meeting place could be found than the one selected and secured. Ample room is assured, and the opportunity of inspecting the extensive equipment of the power plant will be appreciated by the delegates and visitors.

The committees in charge are working hard to make the 27th the best Convention yet and its success seems assured.

A splendid article, fully illustrated, describing the Technical School, and especially its power equipment, will appear in our July issue. Also an outline of the programme of Convention proceedings and pre-Convention news.

Many advertisers will run unusually interesting and informing advertisements, and the issue as a whole will carry quite a Convention atmosphere. None of our regular features will be neglected, of course, but to the hundreds of engineers both far and near who will be unable to attend the Convention in Montreal, the July Power House, particularly in respect to the Exhibits, will prove a very delightful and valuable substitute.

THE POWER HOUSE
143-153 UNIVERSITY AVENUE TORONTO, ONTARIO

Power Equipment

Steam Engines and Turbines, Return Tubular and Water Tube Boilers, Heaters, Pumps and Condensers

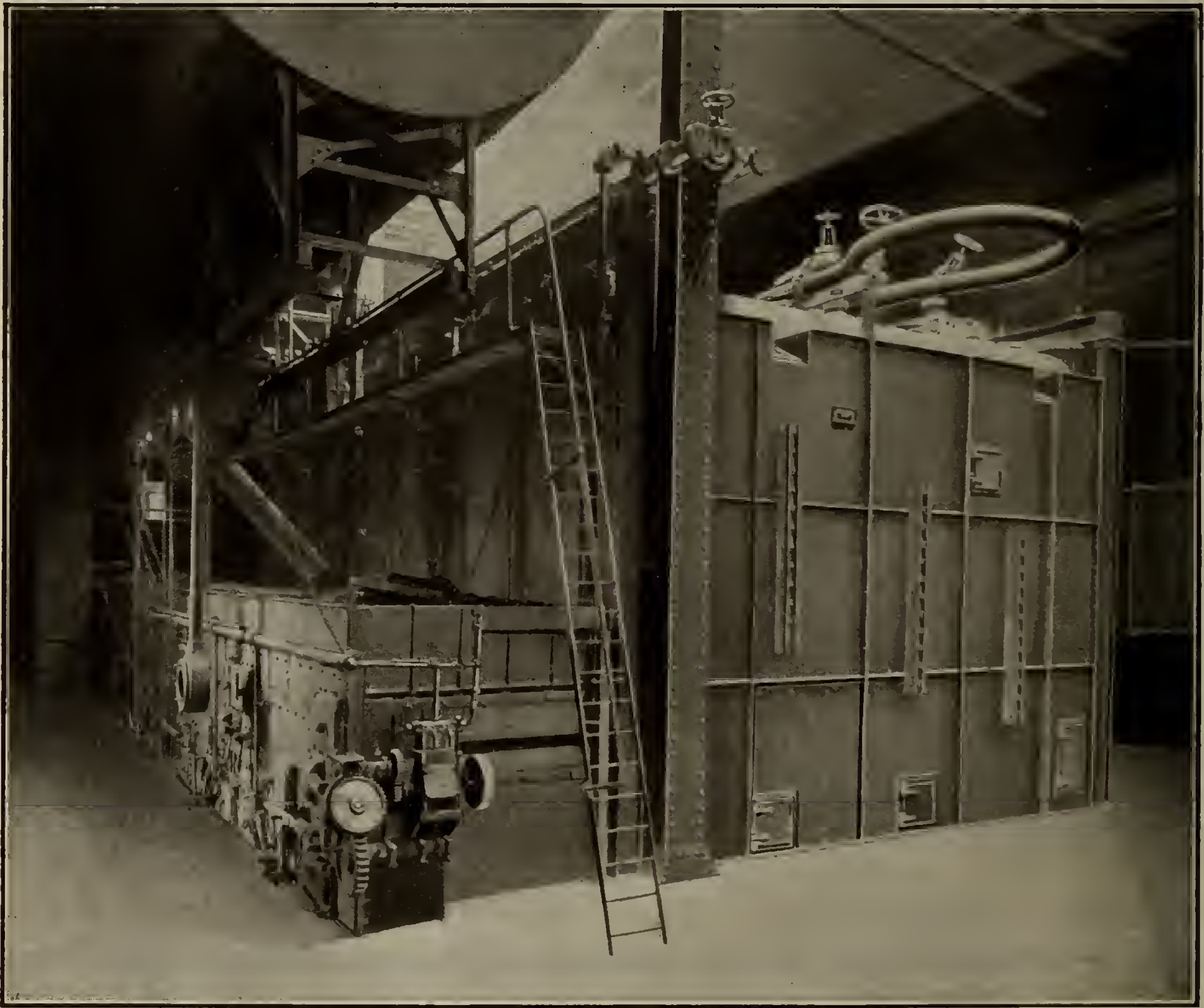


Illustration shows the Boiler Room at the New Asylum for the Insane, Whitby, Ont. equipped with 4 G. & McC. Co. Sectional Water Tube Boilers.

The Construction of G. & McC. Co. Water Tube Boilers meets the demand for higher quality. EVERY PART SUBJECTED TO STEAM PRESSURE IS MADE OF FORGED STEEL. They excel in positive and rapid circulation and in increased Steaming Capacity. Ask for our catalogue and more detailed information if interested.

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Power Plant of the Eastern Car Co., New Glasgow, N.S.

Staff Article

In the matter of equipment installed for the specific manufacture of freight cars of all types in wood or steel, this institution is pre-eminently up-to-date. Such accessory equipment as that relating to power generation and application, here described and illustrated, will be found expressive also of the latest achievement in each of these particular directions.

THE enormous amount of railway construction which has taken place in Canada in recent years, and is still progressing, although curtailed to some extent on account of the war, not only as to the main trunk lines of the three transcontinentals, but also as to their double trackings and the intricate network of branch lines, which is gradually altering the agricultural and industrial features of the entire Dominion, necessitates a very large amount of rolling stock material. The opening up of new territory and the consequent increase of trade and population, each contribute to a brisk demand for rolling stock.

The Organization

The Eastern Car Co. began operations in September, 1913, and since that time has developed a system of manufacturing capable of producing forty cars daily. The market for these cars—at home and abroad—is easily capable of absorbing the entire output. Freight cars of all types in wood and steel are being produced.

The company is a subsidiary of the Nova Scotia Steel & Coal Co., the properties of the two concerns being adjacent to each other on the banks of the East River at New Glasgow, N.S. The recent improvements on this river enable ocean-going vessels to land direct at the company's wharf, giving them exceellent shipping facilities by both rail and water. The plant was designed and constructed by Horace H. Lane, consulting engineer, Detroit, Mich., who had an organization on the work until the whole was in complete operation. The site embraces some 65 acres.

Material Handling Efficiency

There are few engineering institutions in which so great a variety of heavy material is handled in such large quantities as in a freight car plant; therefore, to be efficient, everything must be so arranged that the various materials travel forward steadily from the time they enter the plant until they emerge in the finished product. In some plants the various parts of a car are made in separate buildings, and taken from there to the erection shop, where they are assembled. Some parts, however, go to two or three different buildings before reaching the final assembly.

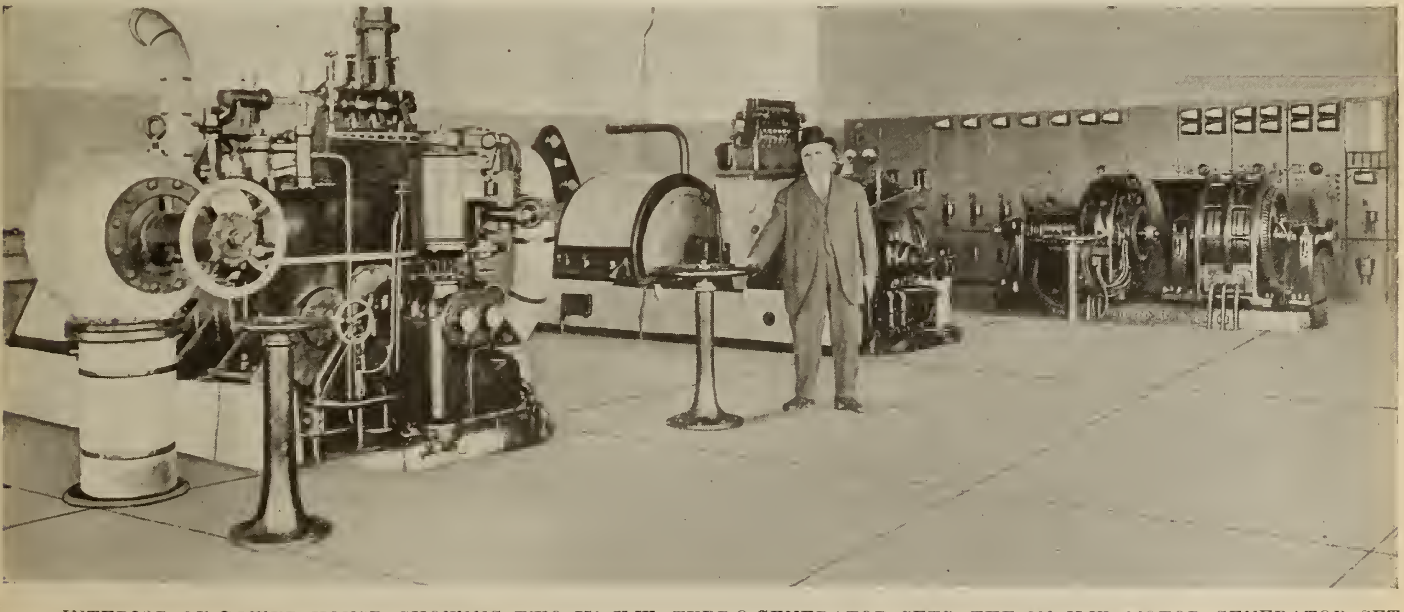
In this plant it has been aimed to eliminate as far as possible the unnecessary transportation of material and the different departments are for this reason largely centered under one roof, this having the additional advantage that work is not so much affected by weather conditions as it would be with the departments in a number of separate buildings.

The shops in which the cars are built are the last word in industrial construction as to light, air, warmth and, as already stated, convenience of arrangement. They consist of four parallel buildings, each 1,100 ft. long and 90 ft. wide, all of steel, with concrete foundations and reinforced concrete walls. The storage yard for steel, lumber and other material is at the west end of the plant, the material travelling towards the other end, from whence it emerges as a finished car any type.

The power plant, housed in a separate structure, is close to the west side of the main building, midway along its length, as central as possible without being too far from the supply of condensing water. The condensing water is taken from the East River, 1,000 ft. away. A pump house is built on the shore of this river, containing three electrically-driven pumps with remote control, so that the operator can start and stop them from the power house without the necessity of going to the pump house except for occasional inspection. Water for the boilers and for drinking, etc., is supplied free by the town of New Glasgow.

The Boiler Room

The power house building is 113 ft. by 120 ft., and is divided into separate engine and boiler rooms, with direct access to each. Three Edge-Moor type water-tube boilers of 600 horse-power each are installed; provision is also made for two more. All are equipped with Foster superheaters and Green chain



INTERIOR OF POWER HOUSE, SHOWING TWO 750 K.W. TURBO-GENERATOR SETS, THE 200 K.W. MOTOR GENERATOR SET, AND MAIN SWITCHBOARD.

grate stokers, and the installation is guaranteed for a continuous overload of 50 per cent. Overhead steel bunkers lined with concrete are provided for coal storage and a continuous conveyor handles the coal from the track hopper to the bins. Automatic ash conveyers are also installed. Provision has been made at each boiler for burning wood refuse and shavings, the material being handled by a blower system which delivers it direct to the boilers. Any boiler can in a few minutes be changed from coal to wood or vice versa, an arrangement which, it is found, gives better results than burning wood and coal together. The working pressure is 200 lbs. with 100 degs. superheat. The chimney which is of concrete rises 175 feet above the grates.

Turbo-Generator Equipment

Both direct and alternating-current electric power is used. The alternating current is 3-phase at 600 volts and the direct current, which is used on cranes and variable speed motors, is at 220 volts. The electric power plant consists of two 750-kw. turbines furnished by the Canadian General Electric Co., and there is provision for a third unit of the same size. One of the two turbines installed is equipped with a bleeder attachment, which allows steam to be extracted between stages for heating or dry kiln purposes, the remainder of the exhaust going through the condenser. The other turbine is of the mixed pressure type, and can be run with either high or low pressure steam, or both. A motor-generator exciter set of 35 kw. and a turbine-driven exciter set of 25-kw. are also installed. During the summer months this latter can utilize the exhaust steam from the air compressors, hydraulic pumps and auxiliary machinery, making altogether a very flexible and highly economical combination arrangement.

A Terry turbo-generator of 125-kw. capacity has been installed to take care of overtime loads, such as night and Sunday lighting, etc. A 200-kw. motor generator set provides the direct current, with both steam driven and electric driven exciters. The switchboard and bus-bar arrangement has been designed particularly to make the plant highly flexible. The main circuits leave the power house in conduits and the whole system of electric connections in the power house is arranged with ample space to afford ready accessibility. The turbines are provided with synchronizing motors and are also controlled by a Tirrill regulator.

Compressed Air

One cross-compound, two stage Canadian Ingersoll Rand, Corliss type air compressor of 3,000 cub. ft. capacity has been installed and provision made for a second unit of the same size. A hydraulic system has also been provided, one 3-cylinder compound, fly-wheel high pressure pump being now in service, while the second will be installed when opportunity offers. Two large accumulators are located in the power house to take care of load fluctuations.

Heating and Ventilating

The main building is heated by four large fans and heaters provided by the Canadian Sirocco Co., these units each containing tiers of indirect radiation heated by exhaust steam from the power house. A Sirocco fan on each unit distributes the heated air through ducts to the various parts of the shop.

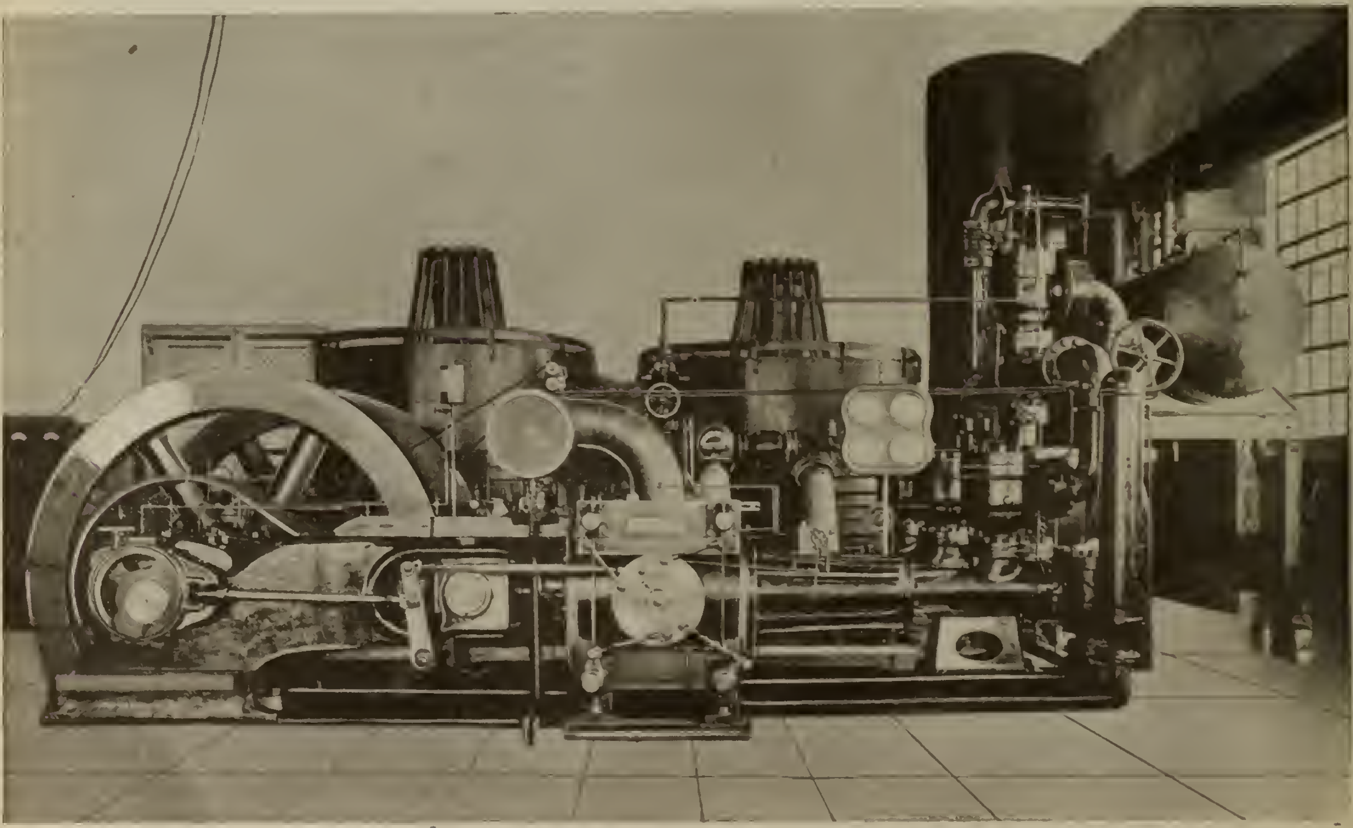
Beginning at the power house and extending across the entire width of the main building, a tunnel 6 ft. 6 in. by 7 ft., is provided with smaller branches leading to the various departments. In this tunnel are placed the main electric cables, steam, exhaust, air, and hydraulic piping, making it all readily accessible for inspection and maintenance.

Boiler Feed and Other Pumping Units

Other power plant equipment consists of two Weir boiler feed pumps; Blake-Knowles feed water heater, Martin pump for taking care of heating system returns, Laidlaw-Dunn-Gordon hydraulic pressure pumps, two H. R. Worthington condensers of 1,600 and 3,100 sq. ft. of surface respectively, Blake-Knowles air pump, and Terry turbine-driven centrifugal pump.

Lighting Provision

The principal lighting throughout the plant is by means of flaming arc lamps, but in the power house and smaller buildings large tungsten lamps are used.



LAIDLAW-DUNN-GORDON HYDRAULIC PRESSURE PUMP IN POWER HOUSE.

Power Transmission Section

TRANSMISSION SAFETY—I.

An important factor in securing freedom from accidents in machine shops and factories generally is the proper safeguarding of the apparatus used for power transmission. In a large shop that does not have individual electric motors for its various machines, a great many belts are used; rope and chain drives are also employed occasionally. Numerous accidents occur in connection with equipment of this kind, which may be divided into two principal groups—the first comprising those due to the breaking of the belts, ropes, and chains, and the second, which is more important, including those in which the hands or clothing of workmen are caught in the moving transmission apparatus.

Belt Depreciation

Wear and deterioration of belts may be caused in various ways. Frictional heat injures leather belts by burning the fibers, and this action is particularly rapid when the belts slip excessively. Belts hanging loose on revolving shafts, and even in operation, may be rapidly worn away by abrasion when the air of the shop contains gritty dust. Temperature, moisture, the tightness or looseness of the belts, and the general condition of the lacings and fastenings, all have an influence upon the life of the belts, and also upon their efficiency in transmitting power. Driving chains wear chiefly by the friction between the links and the sprockets.

In case of deterioration from any of these causes, it is only a question of time when breakage must occur, and then the results are likely to be serious. When a belt breaks the adhesion between it and the driving pulley sometimes holds the belt long enough for it to roll up, after which it is shot off at a speed comparable with the speed of the pulleys over which it runs. At short range a roll of this kind may be as deadly as a cannon ball, and it takes no very active imagination to picture the result, when it is discharged into the midst of a busy shop. A broken belt may also start to roll up, get caught, and then pull down a section of the line shafting. The only method of preventing these accidents is to provide suitable guards for the belts so that even if they break they will not be thrown off. Frequent inspection to remove dirt and grit, and to find weak places, is also of great value. If the belts are seriously worn, the expense of replacing them should not be spared, because the added efficiency and greater freedom from accidents will be ample compensation.

Unprotected Belts

The second general kind of accident caused by transmission apparatus is that in which a workman is caught in a moving belt by his clothes or hands and thrown to the floor or whirled about the shafting. This is one of the most fearful of all industrial accidents, resulting in serious mutilation in almost every case, and we could easily fill pages with the awful details of accidents of this kind. The only way to eliminate such hazards is by carefully guarding all power-transmission equipment where there is the slightest probability of a workman getting caught.

A general point that should be considered in the installation of belt guards is the arrangement of the power-transmission apparatus. This is most important, of course, when a complete installation of new machinery is about to be made; for in cases of this kind it is far easier to safeguard the belting properly, if the shop is laid out with due attention to the needs for the guards. When no preliminary thought is given to the subject of safeguarding, the chances are that no guards will be installed, or else the work will have to be done subsequently at a much greater cost, and will cause more or less temporary or even permanent inconvenience. Moreover, human nature is constituted so that when it is inconvenient to do a certain piece of work, a reason can usually be found for delaying or entirely neglecting it; and when it is the guarding of transmission apparatus that is under consideration, this reason will often be considered to hold good until an accident occurs.

Belt Guard Types

A preliminary study of the problem, at the time the shop is laid out, makes it possible to have the guards installed so that they will not obstruct the aisles or passageways, nor interfere with the working, repair, or inspection of the machines. It may also be decided, in this general plan, whether open methods of guarding by means of rails of pipe or angle iron are to be used in certain locations, or whether it is better to entirely inclose the apparatus. All vertical and inclined belts (and rope drives also) should be completely inclosed to a height of at least 6 feet above the floor, if the guards must be less than 15 inches from the belts. Guards of pipe or angle iron may be used, if they are at least 24 inches high and are placed 15 inches or more from the belt, rope, or pulley that is to be guarded.

Let us assume that a pipe-rail guard is placed about a belt transmitting power from the main shafting on the floor below to a machine on the floor above. If the guard is close to the belt a workman leaning against the guard on the floor above may have some part of his clothing drawn into the narrow slit in the floor by air suction, or by the belt-lacing or clips, and unless the cloth gives way a serious accident may result.

Belt Hazard Important

It is of course logical that the speed and the width of the belts should be taken into account in estimating their hazards. All overhead belts, six inches or more wide, that run at a speed of 1,800 feet or more per minute should be very substantially guarded. The wire-mesh guard framed with angle iron, or the ladder guard turned over at each end so as to include the pulleys, is recommended. In the case of the ladder guard the rungs (if rungs are used) should be close enough together to prevent the belt from falling to the floor in case a break occurs. It is very much better, however, to use lattice work instead of rungs, between the sidebars of the guard. If the upper part of a horizontal belt or rope drive is less than 6 feet above the floor, the belt or rope should be completely inclosed on the sides and top or guarded by a standard railing located at least 15 inches from the belt. Unless the lower part of an overhead belt is 7 feet or more above the floor, the belt should be guarded both on the sides and bottom.

HUMPHREY GASOLINE PUMP

CONSIDERABLE interest was aroused some time ago when an English engineer by the name of Humphrey adapted the principle of the gasoline engine to a direct acting pump, in which the usual iron piston of the engine is replaced by a column of water, on which the pressure of the explosion is exerted. By a suitable arrangement of passages the operation of a four-stroke cycle was maintained, the construction of the apparatus rendering it particularly adapted for dealing with large quantities of water, the Chingford reservoirs of the Metropolitan Water Board, near London, being a conspicuous example of its successful application.

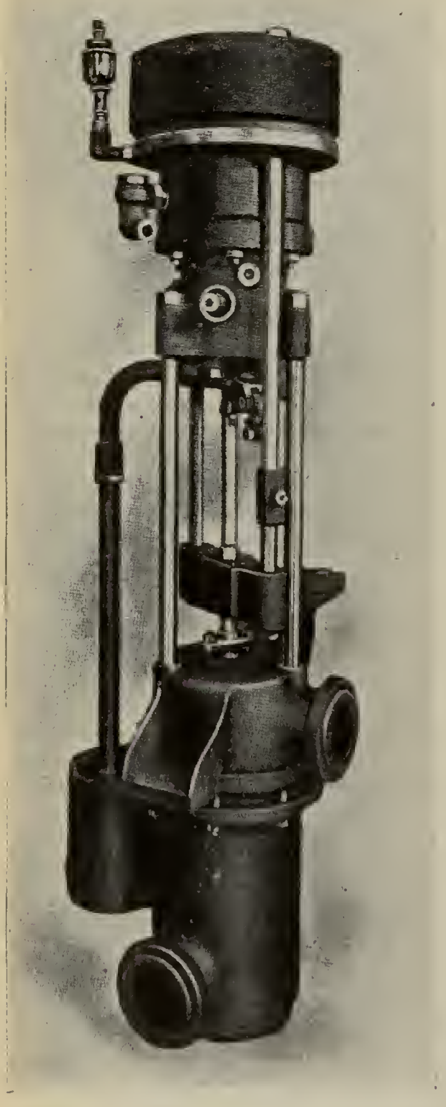


FIG. 1. EXTERNAL VIEW OF 3-INCH PUMP.

Certain features of the original pump prevented its use in small sizes, but the merits of the principle have induced the Humphrey Pump Co. to bring out a new type in which the gravity effect of the original water column is obtained by the use of a vertical reciprocating mass of metal.

The new type of pump is arranged to work on the two-stroke cycle, using ordinary gasoline, and is similar in appearance to a vertical simplex pump. The external appearance of the 3-in. pump is shown in Fig. 1, and a part sectional elevation in Fig. 2, the latter showing clearly the explosion cylinder with its valve gear. The pump barrel or water end is bolted to the pump cover, which has projecting feet, on which the weight of the whole structure rests. Three vertical columns or struts extend upward from the pump cover and support the cylinder A, containing the piston B and piston rod C. The latter passes through a suitable packing gland, and carries on its upper end the massive cast iron block P, which is connected by means of two vertical side rods with cross-head Q, to which the pump rod D is fastened. The pump bucket E has a disc valve F on its upper face, and a similar valve G is placed in the bottom of the barrel.

Pump Single-Acting

It will be seen, therefore, that the pump end is single acting, the pumping of the water being done on the up-stroke only. As already mentioned, the cylinder A acts on the two-stroke cycle, and being arranged so that the force of the explosion is exerted upwards, an impulse is accordingly given to the pump bucket on every upward stroke.

Surrounding cylinder A is a water jacket, and above this again is an annular space M connected with the cylinder space by ports L. Assuming that a charge has been fired with the parts in position as shown, the piston travels upward, passing the ports L and enclosing a small volume of mixture which cushions the piston as it comes to the end of its stroke. Before the lower edge of the piston reaches ports L, the exhaust valve in the lower end of the cylinder is opened by bell crank K actuated by cam R. This relieves the pressure of the exhaust gases so that the mixture in space M, which is under slight compression, may force all of the exhaust gases out through the valve when the piston uncovers the ports on its upward travel.

The weight of the moving parts now causes them to descend, the exhaust valve closing at the same point as it opened, so that the fresh charge is compressed to a pressure of about 200 lbs. per sq. in., thus acting as a cushion to stop the moving parts. At the lower limit of travel, ignition of the charge is effected by a contact maker U, by altering the position of which it is possible to shorten the stroke, the absence of any revolving parts removing the possibility of danger due to pre-ignition where there is a dead centre. A rubber buffer S on the top of the cylinder prevents damage should leaky valves or other causes allow the weight to descend too far. In the larger pumps of this type the cylinder head telescopes into the weight and cushions on the enclosed air.

The starting of the pump is done by a barring lever acting underneath the cross-head, which forces the parts up till the mixture in space M has access to the cylinder. When the lever is released the moving parts fall and commence their functions, as already described.

These pumps can be operated on artificial gas, producer gas, or gasoline, and are being adapted to paraffin and heavy oils. The 3-in. pump shown can deliver 9.200 gals. per hour against a head of 8 ft., and with suitable water end will operate against a head of 172 ft., delivering 575 gals. per hour. The gasoline consumption is five-eighths of a pint per hour, and the weight 350 lbs.

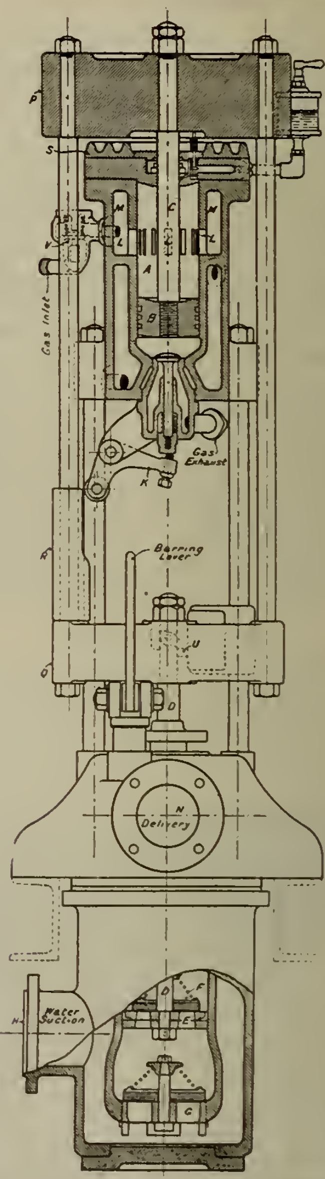


FIG. 2. PART SECTIONAL ELEVATION.

* * *

THE life of belting is chiefly dependent on:—1—the "total load" to which it is subjected; 2—how the belt is joined; 3—the speed at which it runs; 4—the care bestowed upon it; 5—whether it is kept free of mineral oils.

Light, Heat and Ventilation

INSULATION OF STEAM PIPES AND OTHER HOT SURFACES

by T. W. R.

THE insulation of steam and return pipes is of much importance. There is no detail of the heating and power plant which gives better returns for the money invested. A low pressure steam heating main will give off approximately 2.1 heat units per square foot per degree difference in temperature between the temperature of the steam and the surrounding air. At 100 pounds this becomes 3.1 heat units. From 50 to 88 per cent. of this may be prevented by the use of insulating pipe covering. The higher the steam pressure the greater the resulting difference in temperature, and consequently the greater the loss of heat; therefore, the higher the pressure the higher the grade of insulation required. Similarly, the higher the steam pressure, the thicker the insulating material should be. Standard thickness of pipe covering varies from ¾ inch in pipe coverings for ¾ inch pipe, to 1¼ inch or 1½ inch in pipe covering for 12 inch pipe. Ordinarily, standard thickness means approximately these thicknesses.

Steam Main Covering Only

In some installations the steam mains are covered, while covering is omitted from the return pipes. There is little warrant for this, although in the case of the vacuum system it offers fewer disadvantages, in-as-much as the pumps handle better the cooler water. The covering of return pipes is often seriously damaged by mechanical injury as such pipes are usually of necessity located near the floor.

Condensed steam in steam pipes is increased by bare radiating surfaces, in consequence, annoying and troublesome water hammer with its attendant evils result. The amount of water present through condensation may be appreciated when it is considered that uncovered 6 inch pipe, 150 feet long, carrying 3600 pounds of high pressure steam per hour will condense, approximately 6 per cent. of the total steam carried, through radiation.

In the general estimation the magnesia covering, consisting of 85 per cent. pure carbonate of magnesia and 15 per cent. of pure long asbestos fibre ranks highest as an insulator for steam surfaces. Equally efficient, however, is the asbestos sponge-felted pipe covering, consisting of 50 to 60 laminations per inch of thickness, composed of pure asbestos fibre interspersed with particles of ground sponge and other inert fireproof material. In the same class is the asbestos fire-felt covering consisting of 85 per cent. by weight of pure long asbestos fire-felt covering and 15 per cent. of finely ground inert fireproof bonding material, the fibres not being pulped or moulded, but rather felted together. The above only may properly be regarded as, or used for, high pressure covering, that is, pressures above 75 pounds per inch. A cheaper covering means a greater loss of heat.

Intermediate Pressures

For intermediate pressures, it is desirable to use the same grade of covering, but, if less expensive covering must be used, the asbestocel covering may be substituted at a less expense. This is similar to the well known air cell covering, except that the cells are so placed as to run concentrically with the pipe, each cell being closed against the next adjacent cell. The material of which this is made consists of 70 per cent. pure grade asbestos fibre and 30 per cent. inert fireproof bonding material. Standard air cell covering is made with the air cells running longitudinally with the pipe. While this is sometimes used for intermediate pressures, it is not as efficient or durable as the asbestocel covering. For low pressure heating pipes, the air cell covering may be used to advantage. A cheaper covering is the asbestos moulded pipe covering, but this contains only seven to eight per cent. of asbestos fibre, the balance being finely divided inert fireproof bonding material, largely plaster of paris.

The first three coverings 1 inch thick will save about 80 per cent. of the heat lost in bare pipes, the asbestocel 72 per cent., the standard air cell 65 per cent., and moulded asbestos covering and asbestos cement 58 per cent. Thus the loss with the latter is about 2 1-3 times greater than with the first for the same temperature difference. Hair felt, although a good insulator should not be used on steam surfaces because of the fact that the heat disintegrates the hair, and, as a result, the covering is short lived. This is true even though the hair felt covering may have an interlining of asbestos paper.

For use on fittings and irregular surfaces, asbestos cement, sometimes termed "cement felting" is used. This is a plastic cement which should consist of 70 per cent. of pure asbestos fibre and 30 per cent. of inert fireproof bonding material. As usually applied such a high grade of this cement should cover 30 sq. ft. of surface 1 inch thick per 100 pounds. The cheaper asbestos cements weigh more and consequently cover less area per 100 pounds and are less efficient as insulators. For very hot surfaces, an air cell covering called Vitribestos is sometimes used. This is used as smoke stack lining or uptake covering and tube door lining. Pipes in cold air chambers should have two layers of covering of standard thickness. Blow-off pipes and outboard vapor pipes need not be covered.

Applying the Insulation

It is particularly desirable that all pipe covering should be applied by the manufacturer of the materials used. If left to the workmen of the heating contractor, the work will probably be improperly done, and to allow one covering contractor to apply the materials made by another involves a division of responsibility which is not desirable. The covering of standard small fittings may be moulded or may be of plastic cement, but should be of the same thickness as adjacent pipe covering.

Flanged coverings may be made removable and replaceable if made of sponge-felt or fibre-felt covering, first applying rings on the adjacent pipe of sufficient thickness to build up the covering to the maximum diameter of the flange, and then applying sectional pipe covering over the rings and flange together. These should be divided on longitudinal axis of the pipes and finished in cement with 10 ounce canvas neatly sewed on.

Concealed risers may be covered with air cell or moulded covering, and where space is limited this may be reduced to ¾ inch thick. Where the riser is exposed, a 10 ounce jacket should be sewed on in a continuous length from the floor to ceiling, fitting snugly about the various connections, the seams to be made on the back of the pipe where they will be least observed. It is desirable also that the risers be painted one coat of glue size and two coats of best white lead paint to match the color of the walls.

Hot Water Piping

Hot water pipes may be covered with air cell or asbestos moulded covering, or even with the standard wool felt sectional covering having an interlining layer of heavy asbestos paper. Cold water pipes in occupied rooms which are warmed to ordinary temperatures, and particularly in boiler, engine and pump rooms, should be covered to prevent sweating. The material used for this purpose should be pure cork free from artificial bonding material, approximately 1½ inch thick, the material to be finished inside and outside with a damp-proof rubber composition. A canvas jacket may be sewed on.

The smoke pipe and uptake connections, and also any overhanging parts of boilers which are heated, should be covered with 1 inch of asbestos blocks wired on, over which there should be applied 1 inch of asbestos cement felting thoroughly wired on with a hard smooth finish. In large installations this material should be applied over a 1 inch air space made with ½ inch mesh No. 19 galvanized iron wire and 1 inch nipples, using four nipples to the square foot. The boiler tops, where not enclosed in masonry, may well be covered with 1½ inch air cell blocks with 1 inch asbestos cement finish. A ½ inch additional asbestos cement and Portland cement mixture will give a hard durable surface to this covering.

Equipment Unit Insulation

Sectional boilers, feed water heaters, hot water boilers, pump receivers, separators, extractors and other hot iron surfaces of irregular form may be covered with 1 inch to 2 inch of asbestos cement felting wired on and finished smooth and hard. Where desired, a 6 ounce canvas jacket may be sewed on over these cement surfaces, although this is not customary. As a substitute for the light weight canvas, which is more like cheesecloth, a 10 ounce canvas jacket may be sewed on over pipes in finished or ornamental rooms. This is often done in engine rooms where appearance is an important element. On pipes placed in tunnels, trenches, manholes and pits, a waterproof roofing paper bound on with No. 18 annealed copper wire, the wire being passed around the covering and fastened at 6 inch spaces, is a desirable substitute for the canvas jacket.

Hot air heating ducts in walls and in outside walls should be covered with ½ inch asbestos sheets throughout their entire length. Ducts and indirect radiator casings in finished rooms may well be covered with ½ inch air cell sheets and ½ inch asbestos cement felting. If further consideration need be given to appearance, an 8 ounce canvas jacket may be pasted on to this cement surface and the surface may then be painted one coat of glue size and two coats of white lead paint of color desired.

Where desired, the pipe covering may be painted, either with water paint which may be applied without the glue size (preferably in two coats), or with best white lead paint of any color desired. Where lead and oil paint is used, a glue size must first be applied, as otherwise the lead and oil will sink into the insulating material, lessening its efficiency and losing the effect of the paint. Brine and ammonia pipe coverings should always be of cork, brine pipes being covered 3 inch thick, and ammonia pipes 2 inch thick.

Manifestly, pipes should not be supported by clamping directly to the pipe covering. The fire hazard of steam pipe and other hot surfaces when near or in contact with wood or other combustible material has been thoroughly investigated by the National Fire Protection Association and other underwriters. Their various requirements for the insulation of such hot surfaces and protection of adjacent woodwork, space between, etc., should be followed out, a discussion of such protective measures being outside the scope of this article.

TEMPORAY PIPE FITTINGS

FOR many jobs needing light for short periods it is usual to run temporary pipe lines for gas, and very often men not accustomed to pipe fitting are put on the job, the result being that in many cases the supply of gas is poor, while in addition there is considerable leakage. It therefore becomes necessary for the man in charge of the job to pay attention to the points necessary to secure at least decent results.

In the first place the pipes must be of sufficient size for the supply of the number of lights. This varies with the distance from meter or other source of supply, and the gas pressure available, and no universal fixed rule is possible. Next to that it is necessary to see that the inside of each length of pipe is clean and clear from obstruction (particularly must spiders' webs be cleared out). A wire or thin rod with a bunch of wires on the end should be drawn through dirty pipes. The pipes must be run along without bagging, and as straight as possible, and the joints must be screwed up thoroughly tight and not merely hand-tight.

A little white lead, reduced to paint with raw linseed oil, may usually be placed on the screwed ends of the pipe before they are jointed up with advantage, as this makes them gas-tight, but easily broken when necessary. Ordinary gas-tongs of the sizes required for the pipes are the only tools of a special character needed for this kind of work, and as a general thing they are the best where regular pipe fitters are not required. As far as possible the pipes should be run direct from the meter to the lights, that connectors may be avoided, and usually with a little foresight only a few short lengths will have to be cut and screwed. Water and steam carried through small wrought pipes would be arranged on the same lines, but a better class of pipes would have to be used to resist the pressure.

FAST AND LOOSE PULLEYS

IN places where high speeds are used, if the loose pulley is simply faced square and bored out true in the way adopted in many works, there is a tendency to score and cut the shafting, and while this may not be dangerous on a good fibrous piece of metal, it is not too safe where metal is used which is liable to crystallize when fatigue sets in. Outside any chance of danger, however, shafting which is scored is often awkward to deal with should alterations be needed, and if preventable the scoring should be avoided. To prevent trouble caused by the boring of the loose pulley itself, the edges of the boring should be rounded off and the cuts made should be finished smooth.

In a general fit up of a pair of pulleys, the keyway should not extend beyond the edge of the fast pulley next the loose one, as this last pulley should run on quite round shafting, especially where there is much dirt flying about. The collar should fit well and the set screw should not project above its surface, one of the many makes of safety collar or screw only being used. In fact, with all collars and similar projections from revolving machines there should be nothing to catch in the clothing of the persons employed on and around them. From time to time it is desirable that the collars shall be slacked and the loose pulleys run back and cleaned as well as the part of the shaft on which they run, as it not infrequently occurs that oil and dirt accumulates in the form of ridges, which are not beneficial to the working of any parts of machinery. Of course, some kinds of work are worse than others for free moving parts, but in all factories where much work is done, dirt and dust is unavoidably produced, and carried about by the air.—Pract. Engr.

Electricity and Hydraulics

POWER FEATURE IN MANUFACTURING

By "Onlooker"

THE matter of power is apt to be overlooked to some extent in most industries in which it plays a part, and although in the engineering world it gets, perhaps, a greater degree of attention than in many others, it does not get quite all the attention it deserves. It has been estimated that in all industries the average percentage of the total cost of production which is expended in the generation of power is only about six per cent. The writer ventures to think that under existing circumstances this is a low estimate, at least as far as the engineering industry is concerned, in which ten per cent. is probably nearer the actual figure when all factors are taken into consideration. At the same time, given power plant of an efficient nature and modern distribution methods, there is no reason why the cost of power should exceed five per cent. of the total running costs of any plant, while under favorable conditions it may be considerably less. In these days of strenuous competition cheap power may just be the factor which forms the dividing line between a profit and a loss.

Favorable Power Supply

In this country the majority of engineering concerns are fortunate in the matter of power. Located for the most part in industrial centres which are supplied with hydro-electric power at low rates, the power problem is largely solved. Electric power is of all forms of power the most adapted to the engineering shop, and where this is available at reasonable rates from public mains the difficulties of an economical power supply are reduced to a minimum.

Even in such favorable circumstances a study of economy is advisable, as it is a profitless thing to run up unnecessary power bills. Where cheap current is available a system of distribution giving the most efficient results should be adopted, and in order that this may be accomplished several considerations must be examined. In the first place small motors are generally less economical by an appreciable amount than larger ones, and therefore a large number of very small power units are wasteful in current and are also more expensive to install and run up bigger bills for interest on capital invested and depreciation than a few larger units. On the other hand where a whole shop is run by a few large power units there is a big loss in friction, due to the necessary mechanical transmission, which becomes particularly pronounced when only a few machines are being operated, as often happens during small night shifts or when only a few machines are being operated.

Group and Individual Drives.

Between the extremes of a whole shop being driven from a single high power motor and that of an individual motor to every machine there is a mean course which probably gives the best results. It is to have the larger machines, requiring 15 horsepower and upwards, driven by individual motors, and the other machines grouped in twos, threes, fours or fives, depending on their size, and driven from a common shaft operated by a motor of suitable size. By this method the loss in efficiency due to the use of very small units is largely avoided, while if only a few machines are required to operate at a given time, after the rest of the shop is closed down, it will not be necessary to run the whole of the shop shafting, with its accompanying heavy loss by friction, in order to do so.

Prime Mover Choice

Where public hydro-electric power is not available at a reasonable rate it will usually be advisable to generate power on the premises, and distribute electrically through motors along the lines indicated previously. Of prime movers the choice will usually rest between natural gas, where this is available, steam plant with coal or natural gas firing, and pressure or suction producer gas plant. Whichever of these forms of power is advisable must depend upon the location of the plant. Where good steam coal is easily obtainable, a modern steam plant will probably give the best results, owing to its reliability, and even where natural gas is found it may frequently be advisable to adopt a steam plant fired by gas. Where the only available supply of coal is soft a producer plant will give excellent results in so far as economy in fuel and attendance is concerned, but unless this description of plant is of first class design and cared for by men who thoroughly understand it there is a possibility of occasional breakdowns which may hold the whole plant up for considerable periods and involve losses which its economy will fail to compensate for.

Electrical Energy Feature

Whatever form of prime mover is adopted it is generally good practice to convert the mechanical into electrical energy and to distribute it in the manner indicated above. Direct mechanical transmission is often very uneconomical. Of the gross power developed in the cylinders of an engine it is safe to say that, where mechanical transmission is employed, an average of nearly fifty per cent. of that power is absorbed in friction in the engine, the shafting and belts, while with electrical transmission this loss is reduced to about twenty-five per cent., or even less. In one case which came beneath the writer's own notice no less than seventy-five per cent. of the gross power developed by the engine was absorbed by the mechanical transmission, and this represented a cash loss to the company of no less than $3,000 annually, although the plant was only of 100 i.h.p. This was an exceptional case, but it demonstrates how neglect of power matters may involve a very considerable leakage.

Another argument in favor of electrical distribution where mechanical generation is employed is the gain obtained when only a few machines of the plant are operating on a rush job during the evening or night. Where mechanical power distribution is employed this means that the attendants have to be retained to run the power plant and also that a great deal of the power generated is wasted in running shafting useless save to transmit the power of the engine to that part of the shop where the machines to be operated are located. Where electrical distribution is employed, on the other hand, the addition of a few storage batteries to the plant will enable the engine to shut down at the usual time, the machinery being run by stored energy, and all the shafting which has to be run is that length upon which the particular machine is located. This saves loss of power by friction and also the expense of paying overtime to the engine attendants.

Individual Motor Drives

Individual motors on larger machines are always to be recommended. These are now made so that they operate efficiently over a wide range of speeds, and thus gearing is done away with and a more finely graduated range of speed rendered possible. This last consideration is worthy of notice. There is one speed at which any given piece of work can be machined at a maximum efficiency, and where there are only four, or even eight, speeds on a machine it is not always possible to adjust that machine to the ideal speed. The more speeds there are on a machine the more nearly may it be adjusted to the best possible speed for any given piece of work, and the finer adjustability of the variable speed motor as compared with the mechanically driven tool gives the former a big advantage for this reason.

The cost of installing electrical for mechanical transmission is not very great, while the results obtained may be very great indeed. Where an engineering works is scattered, or is very large, or where it is frequently found necessary to keep a part of the machinery running after regular hours in order to keep up with the work, it will almost always be found that the saving effected by changing from mechanical to electrical transmission will be found to be a paying investment.

Shafting Roller Bearings

A point in power transmission which is worthy of attention is the growing use of ball or roller bearings in place of the older bushed types. Where shafting is employed, whether it be in relatively short individual lengths in case of electrical transmission or in longer units where mechanical transmission is employed, a considerable saving can be effected by adopting ball or roller bearings. Of course this saving is much more marked in the latter instance, but is not negligible even in the former. In one case, which recently came beneath the writer's notice, a certain shop found it necessary to install quite a number of extra machines in order to cope with growing business, and when these and their shafting had been put in it was found that the engine could no longer handle at normal speed the increased load. The management was reluctant to have to install new or additional steam plant at that time, and solved the problem by changing the old bearings for ball bearings. Several other machines have been added since then but the old steam plant is still capable of running the whole shop at normal speed. Whether it would not have been better to have changed from mechanical to electrical transmission is a question, but as the shop in question was not very large, and was built on a compact plan it is probable that the ball bearings gave just as good results as electric motors would have done.

VOLTMETER COIL FOR TESTING TRANSFORMERS

FOR exact determination of the high-tension voltage in testing transformers, an auxiliary winding of a few turns placed on the core and connected to an accurate voltmeter has been used with success. This method was advocated by A. B. Hendricks, jun., in a paper read before the American Institution of Electrical Engineers in 1911, but its accuracy was doubted, and it has not been adopted to any appreciable extent. Mr. Hendricks, however, has recently returned to the subject in another short paper presented to the same institution. He says that, for precise results at all loads and power factors, it is necessary that the ratio of the flux linkage of the coil and the high-tension winding be a constant, the flux considered being the resultant flux linked with the high-tension winding on the main flux or minus the leakage flux combined vectorially.

With the voltmeter coil so placed the I.R. drop is the only real error, which is usually small, and owing to the vector relationship under all ordinary loads it is practically negligible. It is not advisable to compensate for this by the position of the voltmeter coil, as the correction would be exact for one value of the load and power factor only. The impedance of the voltmeter coil itself may be neglected. The accuracy of the method depends entirely upon the design of the transformer and the position of the voltmeter coil. Ordinarily a dynamometer type of motor indicating effective values is employed. If the maximum value is desired a sine wave of potential must be employed, or the maximum value may be determined by an oscillograph. It is suggested that much difficulty may be eliminated by the use of a true sine wave generator, securing thereby avoidance of regulating devices and transformer characteristics liable to distort the wave.

Auxiliary Plant Drives

IN his presidential address to the Institution of Engineers and Shipbuilders in Scotland, W. W. Lackie said that for many years it had been the fashion to use electric motors for driving auxiliaries, but recently it had been shown that when a failure or interruption of supply occurred or where a plant had to be started up quickly in case of a sudden demand, there was delay in getting the auxiliary plant started, owing to the means of driving it having also failed or being deficient. The supply of electric energy to the motors driving the auxiliary plant was obtained from the main generators, either direct or from the main bus-bars at the station. A stand-by supply of energy may be obtained from a battery, so long as the auxiliaries are small, but when it comes to 50,000 to 100,000 kilowatts generating stations, and the auxiliary plant amounts to between 5 and 7 per cent., of the whole station capacity, it means from 2500 to 7000 kilowatts, and for this a battery stand-by is quite out of the question.

PROPER WIRING AND MOTOR PERFORMANCE

THE superintendent of a sash and door factory, where electric motors are used for driving the machines says he finds something new all the time. He finds that proper wiring has much to do with the satisfactory performance of motors. For instance, an 8 horse-power motor did not do the work required, and he was about to exchange it for a 12 horse-power motor. After the new motor arrived he was told that the wire would have to be changed, as the one in use was too small for the necessary current. The wire was duly changed, but for lack of a coupling, the old motor was connected, to be used until the coupling arrived. To the surprise of the superintendent the old motor did the work as well as could be wished.

PECULIAR BEHAVIOUR OF A PHASE MOTOR

AN extraordinary story concerning the behaviour of a three-phase motor is told by a correspondent of the Electrical World. During a heavy rain storm a five horse-power three-phase 220-volt motor erected in a garage suddenly stopped and started again in the opposite direction and ran for a few seconds. It then stopped again, reversed and blew the fuses. On replacing the fuses and closing the switch, the machine ran for several seconds in each direction and finally came to rest.

The electrician who was called in to remedy the trouble was told that the machine had reversed its direction of rotation on two other occasions, and that the direction in which the motor ran seemed to depend on the way in which the switch was closed. When the machine started in the wrong direction the switch was opened, and then after the machine had come to rest it was closed again. A voltmeter connected across the switch blades corresponding to phases 1 and 2 indicated a pressure of 220 volts; across phases 2 and 3 there were also 220 volts, but across phases 1 and 3 the pressure varied from 0 to 440 volts, the voltmeter needle oscillating very much like that of a synchronising voltmeter. These readings naturally indicated that something was wrong on the supply lines.

Inspection showed that the motor was fed from two transformers, some distance apart, and that each transformer was connected in open delta. As the secondaries were properly connected it was suspected that the trouble was in the primaries, as the voltage of the secondary windings was normal. Further inspection disclosed a tie switch in between the primaries, and this switch was open. Consequently the transformers were on separate circuits and were being fed from separate sub-stations. On closing the coupling switch, thus paralleling the sub-stations, the trouble vanished. Excessive load on one station, arising from the stormy weather, caused a reduction in the voltage of that station, and on one transformer, with the result that the motor acted as a balancer. As a final remedy the motor was fed from one transformer only.

* * *

SOME CURIOUS FAULTS IN ELECTRICAL MACHINES

AT a meeting of the East of Scotland Branch of the Association of Mining Electrical Engineers, a paper was read covering unusual breakdowns of electrical machines which had come under the author's notice. One such referred to a large pumping set, consisting of a 200 h.p., 3,000-volt, three-phase slip-ring induction motor driving a ram pump. The motor was controlled by an oil-immersed switch and a rotor switch of the liquid type. The pump and motor had been running well for about three months, when the writer was told the motor had suddenly stopped. The attendant said that there had been a heavy flash at the stator switch, and the lid of the trifurcating box of the outgoing cable had been blown off and the bitumen spattered over the wall. The switch on the panels at the surface had also tripped. On opening up the switch it was found that a short-circuit was taking place between two of the trip coils which were wound with enamel wire. The wires of the coils, which were about 1 in. apart, were found to be burned and pitted where the current had been arcing across.

As it was essential that the pump should be started as soon as possible, and as it would take some considerable time to get a new switch installed, the writer tried putting a sheet of thick mica between the coils. This was done, and then the motor was started up and ran without a stop. On taking the matter up with the makers, they stated that as the switch was tested with 6,000 volts before being immersed in oil, they could not see how it had become defective. When their representative arrived, the writer ran the motor without the mica, when the same thing occurred again, but it did not recur when the mica was again inserted. The author left the district before the matter was cleared up, but was informed that the mica was still in the switch three months afterwards. There was no question of the motor or switch being overloaded.

Squirrel Cage Induction Motor

Another fault was on a 45-h.p. 3,000-volt squirrel-cage induction motor, driving at one end through a flexible coupling a centrifugal condenser pump, and at the other end an air pump by a rawhide pinion. The switching arrangements consisted of an auto-transformer starter with fuses on the running side only, and a main switch which controlled other three motors. The motor was found to be running excessively hot early one morning, and the writer was informed that the main switch had tripped the previous night. The ammeter on the main panel showed the current taken by the motor to be less than normal. An examination of the fuses showed that one was blown. The main switch and the auto-switch were also examined and found in good order. When a new fuse was put in, the motor worked quite satisfactorily.

Oil Immersed Controller

In another case, a fault occurred in a 500-volt horizontal three-phase oil-immersed controller for a 50-h.p. open-type slip-ring motor. On the barrel of the controller there were three short pieces of ½-in. copper rod, completely covered with mica except for ½ in. at each end, used for making connection between the incoming cables and the first step on the controller. One of the copper rods passed under the barrel contact of a different phase, but did not lie in direct contact with it. When in service, the whole barrel of the controller was completely immersed in oil. The rod which passed under the contact of an opposite phase was found to have the insulating cover of mica burned away to a length of 1 in., and the copper was also burned; so that there was a short-circuit between these two phases. This fault worked through all the high and low-tension switches in the sub-station in the pit, and tripped the main switch in the power house with unusual violence. It blew off a part of the cover of the trip coils of this switch, besides causing the needle of the ammeter of the switch in the power house to go right over and stick there. The cover had to be taken off to put the needle back.

Cable Trouble

Some time after the above occurrence a fault took place on a 37/14 three-core armoured bitumen cable used as rotor leads for a 300-h.p. 3,000-volt motor. This was caused by the heat of the place softening the bitumen round the cores of the cable and causing a short-circuit. Immediately the switch was put on, and before the rotor-switch handle was touched, the local switch and the main switch tripped, but the incoming feeder switch did not trip. As there was no resistance in the rotor circuit, the rush of current through the stator must have been enormous.

Here were two different cases of short-circuit, one on a primary circuit and one on a secondary circuit; one tripped the switch on the surface, while the fault on the 3,000-volt circuit only tripped the local and main switches. These switches were all properly set, and worked correctly at all other times, and the author said he failed to see why the incoming feeder switch and the surface switch kept in despite the large current which must have been taken by the 3,000-volt motor.

Alternator Slip Ring Leads

Another case mentioned occurred at a colliery. There was a shaft exciter on the turbo-alternator, and, on the exciting switchboard, earth lamps to indicate a fault. Sometimes one of the lamps burned more brightly than the other, showing an earth on one side of the machine. This occurred two or three times a day, and went away without anything being touched. To prove there was a fault on the machine, the author felt the brush-gear and got a distinct shock. When the machine was shut down, the exciter armature, field coils, brush-gear, and leads to alternator slip rings were thoroughly tested with a megger, and a good test was obtained. All the cables were tested from the terminals of the machine back to the exciting switchboard and were found correct.

The leads from slip rings of the alternator which passed under the soleplate were next examined. The rotor of the alternator was also tested and found clear. The test lamps still showed an intermittent earth, and one of the fuses of the exciter was heating up rapidly. When the auxiliary steam exciter was tried, the fault still showed. It was then decided to replace the leads from the slip rings, and on doing so the leads were found to be saturated with oil. When replaced, the fault was cleared. As oil is supposed to be an insulator, it should not have caused an earth, but the fact remains that it did so. Since these leads were replaced there has never been an earth indicated by the lamps.

* * *

Crank Chamber Explosions. — Explosions have occurred, states a writer in Vulcan, in connection with the Crank-chambers of high speed engines in which the crank-pins are lubricated by spoon. The agitation of the oil raises a kind of oil-mist which is easily ignited by a lamp inadvertently inserted for examination of bearings, etc. Obviously, the formation of oil-mist in this way is promoted by the heat from a defective bearing.

REFRIGERATION DEPARTMENT

AMMONIA IN REFRIGERATING SYSTEMS

In the course of an address on the origin, manufacture and practical application of ammonia, by A. Loewenstein, before the Chicago section of the American Institute of Brewing Technology, it was observed that there had been much discussion relative to gases termed by the operating engineers frequently as "foreign," "Marsh," "Methane," "Hydrocarbon," "Foul" gases, etc.

Gases in Compression Machines

In the case of compression systems, any gas introduced into the system through the ammonia would, of course, be of the character which was in the cylinder prior to emptying it. The majority of the leading brands of ammonia to-day contain only limited amounts of such gases. Repeated analyses of the gas which lies above the liquid in anhydrous ammonia cylinders have shown that this gas is mostly a modified air.

Air, as we know, contains approximately 80 per cent. nitrogen and approximately 20 per cent. oxygen, and in most cases the analyses made of different brands of ammonia have shown a large amount of nitrogen present and less oxygen than is normal to air. Several hypotheses have been advanced to explain this condition. Some have stated that the deficiency of oxygen has been due to its absorption by iron, forming rust, or possibly by the lubricating oil used in the compressor. This may or may not be the correct explanation. Some of the oxygen may possibly have been absorbed in process of manufacture, by some of the impurities of a phenolic character in the initial material which are known to be capable of absorbing oxygen. Many analyses of gas have been made, both that dissolved in the liquid ammonia itself and also of the gas which lies above the ammonia in the cylinder. In most cases they simply consist of nitrogen and oxygen in somewhat varying proportions. In one case some four of five years ago hydrogen was found present, but possibly at that time metallic sodium had been used for removing the last traces of water from the product.

Analyses of condenser gases from a number of operating compression systems have usually revealed the presence of a limited amount of hydrogen. Samples were taken from systems using various kinds of anhydrous NH_3. In practically all of these systems a small amount of hydrogen has been found to be present when gases have been withdrawn from the purge valve on the condensers. In some cases there has been as low as 0.5 per cent. and in others as high as 3.5 per cent. hydrogen present. Typical analyses of three different systems may be of interest. In one there was no hydrocarbon gas present whatsoever and no carbon monoxide or carbon dioxide. The nitrogen content was practically 83.5 per cent., hydrogen content practically 3.5 per cent., and the oxygen about 13 per cent. In another system different ammonia was used, and the hydrogen content was approximately 3.5 per cent., the hydrocarbon content approximately 0.75 per cent., oxygen about 13 per cent., and the balance nitrogen. In a compression system at a plant which has been operating a number of years, the analysis of the gas showed 0.5 per cent. hydrogen, 15.5 per cent. oxygen, no carbon dioxide nor hydrocarbon gas, and the balance nitrogen.

As stated above, a number of such analyses from different plants have been made, and the proper interpretation of such results requires considerable study. From the results of experimental evidence, the writer is not of the belief that, under normal working conditions in a compression plant any decomposition of the ammonia takes place when pure ammonia is employed.

Gases From Lubricating Oils

For two or three years I have had experience of running a small experimental ice machine under all sorts of abnormal conditions, frequently running at a pressure as high as 300 lbs. and maintaining same. Where a good quality of lubricating oil was used and all the air carefully removed from the system at the time of charging, practically no gas formed, even when a working pressure of 300 lbs. was maintained for a number of days. With a low grade of lubricating oil of the character of West Virginia black oil, considerable hydrogen was evolved, in fact as high as 25 per cent. in the gas which was collected from the condenser. It has not been determined as yet whether this hydrogen was evolved entirely from the oil, but it is the opinion at this stage that it was. It was found that when water was permitted to drip continuously on the piston rod of the machine, although the stuffing boxes were kept as tight as possible, a slight amount of water was taken into the machine in this way.

Gases in Absorption Machines

In absorption machines it is the usual thing to find a considerable amount of gas formed. Most operating engineers know that this is an inflammable gas. Analyses of such gas by our laboratory reveals the fact that the major portion consists of hydrogen. For example, from two different absorption machines analyses of the gas showed the presence of, in the one case 90 per cent. hydrogen, 2.25 per cent. oxygen, no methane and the balance nitrogen. From another absorption system the basic gases ran as high as 95 per cent. hydrogen, 2.5 per cent. oxygen, and the balance nitrogen. Such a condition is the usual result in absorption systems. It is also necessary at intervals to remove considerable sludge, which consists principally of iron oxide from the generator.

It is the writer's opinion that this hydrogen gas is not the result of decomposition of ammonia, because you will note in the analyses that there is no equivalent amount of nitrogen which would be present if the ammonia is dissociated. We know that one of the principal commercial methods of the production of hydrogen is by what is known as the steam iron process. This is employed in Germany, for example, on a considerable scale in generating hydrogen for Zeppelin machines. In other words, it is the writer's belief that the hydrogen is formed as a result of the dissociation of water in the form of steam through a very simple reaction of steam acting on iron, combining with the oxygen of the water, forming iron oxide and thereby liberating hydrogen.

Analogous reasoning applied to compression machines would be about as follows: Practically no compression machine is absolutely tight and some water is very apt to get into it at some time or other. At condenser pressure and temperature, which of course are highest when a considerable amount of non-basic gases are present, such action of the steam on iron could easily take place. We must remember at this point that ammonia is a very excellent solvent of iron oxide when it is in the form of rust Fe_2O_3. When the iron is in this state, namely, the rust having been dissolved, a rough surface remains, in which case it is possible that the iron may bring about the reaction suggested above, or it is possible that the surface of the iron in this finely divided state may act as a catalyzer and produce a slight dissociation of the ammonia. The latter is not the writer's opinion, however, and research work is being conducted on this point to establish the exact facts. It has been noted that ammonia is a solvent of iron oxide when it is in the form of rust or in the form of Fe_2O_3. Anhydrous ammonia is practically without any action whatsoever on the magnetic form of iron oxide, namely, Fe_3O_4. We are familiar with the latter in the form of mill scale.

There are a great many difficulties operating engineers encounter in practice. Some of these difficulties are due to poor oil, some to a poorly designed and constructed pipe system. Many engineers are too prone to attribute their difficulties to the quality of ammonia which they employ. Of course, unless they carefully investigate conditions, or consult with someone who is competent to investigate conditions, simply attributing the troubles to the ammonia does not remedy the matter.

Inflammability and Explosition Tests

From time to time attention has been directed to fires or explosions in refrigerating rooms in which a compressor head has blown out and a fire has resulted. A number of such cases have happened in breweries and this subject is now under discussion by the New York Board of Fire Underwriters.

The subject of whether or not ammonia will burn, and under what conditions, has been under investigation in our Research Laboratory for several years. The majority of text books usually say that ammonia will not burn. As a matter of fact, ammonia will readily put out a flame, which is probably due to its blanketing action. The writer is not able, owing to the limited space at his disposal, to go into this subject at any length. Briefly, however, it may be stated from experiments undertaken, that ammonia gas, mixed with air in certain proportions, when ignited will propagate a flame.

Special apparatus has been designed which enables us to determine the conditions under which ammonia will burn, when all known mixtures with air are brought together under suitable conditions; also known mixtures of oxygen and ammonia. These tests have been made in steps of 0.5 per cent., using mixtures varying from 1 to 100 per cent. of ammonia in air, both dry and saturated with water vapor. The results under these conditions were that no visible form of burning was evident until the region of 11 to 13 per cent. of ammonia was reached. It was found that a small yellow flame was produced at 11 per cent. ammonia in air which increased in size with increase of ammonia content until at the proportion of 13.25 per cent. of NH_3 the burning was complete. At this concentration a yellow flame completely enveloped the glass containing vessel and the combustion was sufficiently violent to shatter the vessel. Above this percentage mixture, no apparent burning occurs.

Inflammability Limits

It appears that the limits of inflammation are rather narrow, and it is to be understood that the mixture of air and ammonia mentioned in the experiment cited above were the conditions which obtained in that particular set of experiments. These experiments were made in a darkened room with a black background, so that the appearance of flame could be readily observed. It was even necessary to use a heavy glass shield to protect the operator. After the desired mixture was satisfactorily prepared, electrical connection was made by means of an induction coil and platinum wires inserted into the vessel, forming an arc, causing the spark to pass between the platinum knobs of the electrodes.

Another set of experiments using similar apparatus, was made, but instead of attempting ignition of the mixture with an electric spark, an electrically heated platinum wire was used. As in the preceding, tests were made with a mixture of ammonia and air, varying from one to 100 per cent. of ammonia in air. Results were that up to 5 per cent. of ammonia in air no apparent change took place, except the formation of condensed moisture on the sides of the vessel. From 5 per cent. ammonia to 13 per cent. ammonia in air, there appeared, besides condensed moisture, dense white vapors. From 13 per cent. to 15 per cent. it was observed that the platinum wire remained incandescent, even after the current was turned off and in addition considerable white vapors were formed. After 15 per cent. it increased in size with increasing percentages of ammonia up to 19.58 per cent., at which point the mixture violently exploded upon ignition.

Violent Explosive Tendency

With mixtures between 19.58 per cent. and 26 per cent. of ammonia in air, the explositions were very violent, sufficient pressure being generated to shatter the glass container. From 27 per cent. to 58 per cent. of ammonia in air, the platinum wires remained incandescent after breaking the electrical contact. From 58 per cent. to 100 per cent. no apparent reaction took place. The wire glowed more dimly under these conditions and ceased to glow immediately upon turning off the current. With regard to the white fumes mentioned above, these fumes are lighter than air and condensed upon the sides of the vessel as crystals when cooled and dried. An insufficient quantity was obtained for quantitative analyses, but positive tests were obtained for nitrates and nitrites.

The above results seem to show conclusively that ammonia will burn when mixed with air in certain definite proportions, and when the proper mixture is ignited the burning is sufficiently rapid to cause an explosion. There seems to be a difference in the percentage mixture which will explode. It was found that 13.25 per cent. ammonia in air, when ignited by an electric spark, exploded, and that mixtures between 19.58 per cent. and 26 per cent. ammonia in air exploded when ignited by an incandescent wire. This apparent discrepancy is being further studied. It is possible that a complex reaction takes place when using the electric spark and it is suggested that possibly the formation of ozone and the interaction of the latter with ammonia might occur. Emphasis must be laid upon the fact that the burning point was not due to the continuous presence of the spark, or heater coil, inasmuch as the explosion was instantaneous upon the closing of the electric circuit for a second.

Ammonia Decomposition Not a Factor

From the above it is also evident that the burning was not due to the decomposition of ammonia and the subsequent burning of the hydrogen. The ammonia employed was tested 100 per cent. pure and was made from the highest purity ammonium salts of Kahlbaum's manufacture after repeatedly recrystalizing the salts to be sure that the very purest form of ammonia was employed in this experimental work.

As a result of these experiments, I would suggest that in order to minimize the danger of fire in the ice machine room in case a cylinder head should blow out, that open gas jets and arc lights be dispensed with and that the room be well ventilated. The writer, however, does not wish it to be construed that the sudden release of ammonia into air is the only possible cause of a fire of the character which results at times. As a matter of fact, it is his opinion that lubricating oil in a very finely divided state at an elevated temperature and pressure when suddenly released into the atmosphere would very rapidly become carbonized and might ignite spontaneously. In this connection, Dr. P. H. Conradsen, of the Galena Signal Oil Co., has published a very interesting article describing the effect of air when suddenly brought into contact with oil in an atomized condition in connection with locomotives operating with superheated steam.

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Associate Editors,
A. G. WEBSTER J. M. WILSON
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OUR AWAKENED BUSINESS SENSE AND WHAT'S BACK OF IT

WHEN we consider the number and variety of metal-working plants that have either sprung into existence or have been materially extended as a result of war orders more or less varied and large, and when thought is given to the certain eventuality that this business will one day sooner or later cease, nothing is more natural than that the minds of those responsible for the maintenance and development of our commercial and manufacturing activities, should be exercised in the endeavor to seek new opportunities while simultaneously cultivating more intensely the old. It may be said that the latter is quite normal with respect to the former.

Canadian manufacturers have, so to speak, found their feet, as a result of war-made opportunities right to their hand, by which we mean that they have become alive to their capacity for doing things, and, in consequence, have developed an expertness that was aforetime believed non-existent, and still much less appreciated as being simply latent. Their business sense has been quickened and their outlook broadened, being just comprehensive enough now to manufacture competitive lines of commodities here in Canada to meet the every requirement of our people and share in those of nations further afield.

Our mineral and lumber resources, our steel production, and our manufactures of steel and wood commodities, our harbor, port and navigation facilities and aids, indicate clearly that we possess natural material and locational advantages. In the realm of steel-making, mention may be made of the Steel Company of Canada, with its plants at Hamilton, Fort William, Belleville, Brantford, Gananoque and London, Ont., and at Montreal and Lachine, Que.; the Dominion Steel Corporation, Sydney, N.S., with which is incorporated the Dominion Coal Co., etc.; the Algoma Steel Co., at Sault Ste. Marie, Ont.; the Canadian Steel Foundries with their plants at Montreal and Welland; the Nova Scotia Steel & Coal Co., New Glasgow, N.S., etc.

In the sphere of shipbuilding and marine engineering, in addition to Canadian Vickers plant on the St. Lawrence, we have the Davie Drydock and Shipbuilding Co. at Levis, Que., while on Lake Ontario we have the Kingston Drydock and Shipbuilding Co., the Polson Iron Works, Toronto, the shipyards and drydocks of Muir & Sons, and M. Beatty & Sons at Port Dalhousie and Welland, Ont., respectively. On our Upper Lakes—Superior and Georgian Bay, the shipbuilding plants of the Western Drydock & Shipbuilding Co., and of the Collingwood Shipbuilding Co., have the distinction of being capable of building the largest lake vessels afloat. On our Pacific Coast, shipbuilding and ship repair plants of varied capacity are to be found, while, as a result of the new conditions arising out of the war and the projected service to be afforded by the Panama Canal, steps are being taken to secure a further increase in establishment.

Other directions in which Canadian industrial and manufacturing enterprise has made special headway are those of freight car and locomotive building, heavy marine and other purpose steel casting and forging production, heavy and powerful hydro-electric and its kindred mechanical equipment, electrical instrument and specialty work, machine tool and accessory apparatus, also steam power plant main and auxiliary engines, boilers and contributory mechanisms, agricultural machinery of wide and varied application, etc.

CAPTURING ENEMY TRADE

WE are inclined to think that up to the moment little headway has been made, or more properly speaking, little enemy trade has either been appropriated or negotiated. True it is that much organization toward that end has been created, organization at once influential both from the nature of the commercial interests concerned and from the Governmental recognition exemplified in Trade Commission appointments.

It is quite evident that German trade competition after the war is being anticipated, whether the latter arise from known facts in the possession of those whose official positions necessarily keep them posted as to our enemy activities, or whether it be simply a logical deduction based on enemy experience in the past. No scheme of real practical value has yet been evolved, much less launched, whereby the end sought has been brought appreciably nearer to fulfilment. Suggestion, doubtless, has been plentiful, but all of it displays a lack of knowledge of what there is intended to combat and conquer.

Most of the schemes propounded are, it seems to us, much too ambitious and are indicative of the "wish being father to the thought." They have further the somewhat undesirable tendency to, if not frustrate individuality, at least stifle it, with the result that inaction on the part of commercial and manufacturing managements ensues. Initiative in the unit sense ceases to be a factor, and the impression grows that the task of capturing enemy trade is so gigantic as to require some drastic legislative enactment or something of an equally stupendous nature.

Trade and commerce are constitutionally complex, and in a world-sense are very much so; they are, however, readily amenable to individuality of operation. Their essence is individual enterprise and will continue so to be irrespective of any national or Empire plan of campaign to capture enemy trade. It follows therefore that each Canadian manufacturer should act his own part in the latter direction—in a word set about securing his particular share, and in the event of collective organization or Government enactment materializing, appropriate what further aids these may afford.

It has been said that each manufacturer can think out a plan to develop some part of his business a little more than has yet been done or has even been attempted, and this without waiting for ambitious and all-comprehensive schemes that are probably beyond the ken of human to evolve. Each can be keenly alert and active to seize the many opportunities—big and little now presenting themselves.

The Operators' Point of View

SMALL POWER PLANT INEFFICIENCES

By J. E. N.

ALTHOUGH most medium-sized power plants and practically oll of the large ones use scientific methods in operating, many of the very small ones are run practically as was the custom 20 or 30 years ago, that is by rule of thumb methods. Many of these small concerns have an upright boiler of from 10 to 20 horse-power, and neither the boiler nor the steam piping has a foot of covering other than the roof.

Experiment tests have shown that for every square foot of uncovered steam pipe there will be wasted about 0.76 lbs. of steam per hour. Assuming that the plant contains 300 square feet of uncovered surface, then 300 × 0.76 = 228 pounds of steam per hour. In plants of this kind the evaporation per pound of coal seldom exceeds 7 pounds, therefore 228 ÷ 7 = 32½ pounds of coal per hour (roughly). Let us suppose the loss goes on 60 hours per week throughout the year, then it will reach the total of 48 tons, and with coal at $4 per ton this will amount in money value to the interesting total of $192.

Now the cost of covering the boiler and piping can be done with a fairly good non-conducting material at an average expense of 15 cents per foot for material, therefore the total first cost to do the covering will be 300×.15= $45 plus the labor of putting it on.

The packing used for valve stems in some of these small outfits is on the cheap side to say the least, cotton wick and tallow being very common, being as a matter of fact even used on steam engine piston rods. Of course there are numerous leaks around the stuffing boxes and it can be shown that these many small leaks amount to an almost unbelievable amount in a year if reckoned up.

It is not always the owner's fault that these things are so. The engineer, may be a man who does not believe in reading engineering literature or such like "nonsense," and has quite probably no use for any of these "gol darned" new fangled packings costing a dollar a pound. Probably his method of packing a box is to keep adding new cotton wick on top of the old until he forces out the top of the stuffing box cover.

In all cases, no matter what style of soft packing is used, the old rings should be removed from the box before putting in the new ones..

When overhauling some of these small plants, I have found that ordinary asbestos, rope or sheet, well soaked in oil and graphite, makes a cheap and efficient all-round packing, because, as a rule, the steam pressures seldom exceed 40 or at most 80 pounds per sq. inch.. It is well to remember that asbestos will swell to some extent when wet, so that, in using the rope in boxes, the covers should not be screwed down very tight at the start.

C.A.S.E. CONVENTION

The Annual Convention of the Canadian Association of Stationary Engineers will be held in Montreal, P.Q., on July 25, 26, 27.

Every leakage of steam or hot water means coal wastage, and all leaks, no matter how small, should be stopped. All drips which do not return to the boiler should be trapped. In these small factories or shops the drips seldom exceed ¾ of an inch, and there are many efficient steam traps of this size on the market at present which cost around 5 or 6 dollars, only. With one of these low-priced traps on each drip, the water and steam which is now going down the sewer or elsewhere could be returned to some tank or other receptacle where it could be used again. If owners of this kind of outfit could be persuaded to read a good enginering journal or be induced to supply their "engineers" with one, some good would surely result. It is usually in this kind of a plant that the engineer washes windows, cuts the grass, and such-like odd jobs.

BELT TROUBLE ON GRINDER

By N. G. Near

J. M. says in the April issue of The Power House, "his grinder belt travels 7,290 feet per minute, which is excessive." Yes, such a speed is excessive on drives that are not designed for high speed. Ordinary cast iron or wood pulleys cannot stand such a speed. They are liable to burst. Only specially made pulleys should be used. In general, a mile a minute is the limit.

7,290 feet per minute is not excessive, though, if the drive is designed for that speed. The belt should be made endless. All joints should be well cemented and smooth. There should be no bumps on the belt anywhere, and the whole belt should be smooth so as to eliminate windage losses and so as to eliminate the "air pocketing," to which J. M. refers. Personally, I do not fear air-pocketing much unless the belt is rough or fuzzy. There is every argument to show that air does not pocket easily in any kind of belt and that it does not cause slippage.

It has been proved in actual tests that high speed belts, up to the 12,000 feet per minute, slip less than slow speed belts, and they run satisfactorily where designed correctly. To design a good high speed drive is not easy, but it has been done and can be done.

LICENSE LAWS FOR STATIONARY ENGINEERS

By W. B. Henry

THERE has of late been a lot of letters printed in The Power House on the above subject; and in the April issue a Mr. Foster appears to judge some man "a poor engineer" on account of the piping lay-out shown on page 88.

I do not agree with Mr. Foster, that a man who would connect up a pump and heater as shown is not entitled to be known as an engineer, without a consideration of the causes that led him to do the job. I am willing to state that the man in question very likely understood what he was doing very thoroughly, and also that it was not correct engineering practice, but very likely was "up against it," and he took the only way out. Possibly if we could see ourselves as others see us, Mr. Foster would find some just as questionable ways of getting over a difficulty right at home in his own plant.

The writer has been a stationary engineer in Ontario for years, and has also been examined twice in the United States under a graded law, and each time been awarded a first-class license, so that one would assume that I know better than approve of such a piece of pipe fitting. However, I want to state right here that if I were examiner of engineers I would not disqualify a man for a piece of work as shown in the sketch. The biggest fault in the piping lies in the fact of there being a valve in the main line between the heater and the pump. There should be no valve there.

So far as the soot is concerned it would be very easy to cover the box to keep out the dirt, and further, I cannot believe any man would get enough soot into that box and down through a 1-inch pipe to cause the pump to work badly and, in addition, make the boilers dirty.

Mr. Foster should bear in mind that soot floats on water, and it would be very hard under general conditions to get any quantity of soot down that 1-inch pipe.

The connections shown in the sketch are all right, and even if both valves in the pipe lines leading to the pump are left open wide, the pump would operate OK. as long as the water level remains OK. in the heater, regardless of water condition in the box, for the reason that water flows to the pump by gravity, consequently the water would always be at the same level in the 1-inch pipe as it would be in the heater, thus the pumps would not get air through the 1-inch pipe.

I notice the water line in the heater is just level with the top of water supply line to the pump. This, of course, is too low but, although I have seen some very odd installations, I consider this an error in the sketch; I do not think I ever saw an open heater piped up to a pump without the bottom of heater being above the pump.

HINTS REGARDING CORLISS ENGINES

By T. J. Rogers.

IN stopping a simple Corliss engine it is well to close the throttle slowly and, by shutting off steam, cause the speed to gradually fall away. The throttle should then be slightly opened, and as the speed decreases, if it is seen that the engine is about to stop, stand ready to move the valves.

If the crank is about to stop on or near the centre, a steam valve should be opened slightly and enough steam admitted to help it over the centre and carry it to the desired position for stopping. However, if it is likely to go too far, the valve may be opened in the reverse of the crank's motion and enough steam admitted to stop the motion. This should never be done except when the engine is moving very slowly.

It is of some advantage, although not necessary, to have the cylinder cocks open while manipulating the valves with the starting bar, as it makes possible to open them wider and does not require such a delicate handling, since the pressure is dissipated as soon as the valve is closed. If the cylinder cocks are not opened, the steam confined in the cylinder may expand and move the engine in the opposite direction.

The starting of a Corliss engine should be preceded by the opening of the cylinder cocks. Open one valve very little and allow steam to blow through on one side of the cylinder for a few seconds and then open the other. If the engine is a large one, the starting bar should be used to open the steam valves for the warming of the cylinders. Stand by the starting bar and be ready to reverse the opening as soon as the engine warms up and starts. When the cylinder has been thoroughly heated the valve may be opened long enough and wide enough to carry the crank over the centre.

The starting bar should be used until the engine has speed enough to carry it through several revolutions without steam. Then bring the valves to their central position, remove the starting bar and drop in the hook. After water has ceased to blow from the cylinder, cocks may be closed. The throttle can then be gradually opened to its fullest extent.

DOWN BELOW—WHY?

By J. Ellethorn

SOME time ago a correspondent of the New York Sun contributed the following interesting letter to the columns of that journal:

As time flies, humanity's condition progresses. This is true in all callings save in that of the engineer operator. Years afo the engineer received some recognition. To-day he has been relegated to the rear ranks of appreciation

The old time engineer used low pressures, slow speeds and good horse sense He worked on the earth's surface, and nature rewarded him with a robust constitution, and an abundant supply of hair, which he utilized in the shape of waste. He knew nothing of electricity, pneumatics, refrigeration, ventilation, etc. Two atmospheres meant high pressure, and the fellow who operated the engine with the loudest exhaust was the best engineer.

This is not making light of our predecessors, for that would be doing an injustice. To be fair and honest, the old-time engineers gave to us the essential laws of mechanics. These were based on facts and formed a foundation on which to build future engineering progress. Their labors have been rewarded by one mile per minute locomotion, unheard of rotative speeds, exceedingly high pressures and frenzied mechanics.

Engine rooms to-day are constructed in as economical and concentrated a form as is possible, as far from nature's purifiers, air and light, as rock will permit. In a word the place in every building that nobody wants is given up for the heart and lungs of the structure. In this place the engineering staff is imprisoned for from 10 to 12 hours daily, week days and Sundays. Day and night there is no let up, because if ever the vital organs stop the mighty skyscraper becomes a "dead one." Here the crew inhale foul gases, absorb malaria, rheumatics, develop impaired health and eyesight.

The cellar is the garbage receptacle. The sanitary apparatus is under the supervision of the engineer; carpets are cleaned with vacuum, and the sweeping laden with microbes collected from all over the building, are sent down for his attention. Incidentally he gets heaps of abuse from ignorant, impatient and ungrateful humanity.

If the public knew the difficulties encountered daily in engineering problems, the often miserable conditions, small pay, long hours, poor ventilation, servile attentiveness to duty, of the men under the sidewalk, they would both speak and act more liberally to those who constantly look out for their life and welfare.

Engineering departments are placed low in order to take advantage of the laws of gravitation, also, the nearer to old Nick the more economy in heat units.

Now, boys, firemen, oilers, helpers and engineers, don't gravitate too low; economy in heat units means shorter hours, thereby giving all hands an opportunity to take a glimpse occasionally of this good old hump-backed world. Influences and surroundings dampen ambition.

EASY WAY TO SAVE COAL AND BOILERS

By "Woodworker"

KEEP oil and grease out of your boilers. Scale and soot are good heat insulators and cause much needless coal consumption where they are permitted, but oil is just about as bad and is often more dangerous.

Oil from condensed steam settles to the bottom of the boiler, insulates that portion on which it settles and does two things that must be condemned. First, it keeps the heat out of the boiler and drives it up the smoke stack, wasted.

Second, the portion of the boiler shell on which there is oil becomes overheated, weakens, and "bags" if weakened sufficiently. Bags on a boiler are decidedly dangerous; they frequently are the cause of explosions. There are plenty of good inexpensive grease extractors on the market for keeping grease out of boilers, and they are a good investment.

ENGINEER OPERATOR TRAINING

By J. Thorn

CORRESPONDENCE in recent issues of The Power House revives the old discussion about the machinist engineer. I have written about this thing myself in years gone by to an American journal, and got a mild calling down by the editor in his own special section of the journal for holding the following views:

I maintained that it was not necessary for a man to serve four years learning the machinist trade to make himself a first-class steam engineer, that a man who had put in four years in a machine shop and four years in a power plant would not be as good a practical engineess as a man who had served the full eight years in up-to-date power plants.

The modern engineer must be a sort of jack-of-all-trades, with a smattering of knowledge of each and kindred sciences, and have a full as possible knowledge of steam boilers and engines so far as their construction and safe operation is concerned. He must have knowledge of certain facts in chemistry, bookkeeping, millwrighting, steamfitting and plumbing, understand bricklaying, furnace building and foundation work, and be more than ordinarily proficient in electricity and electrical engineering. Obviously he would be a cracker-jack if he could learn them all from A to Z.

Each one of the foregoing are important to engineers in large plants, and some of them possibly more so than a thorough knowledge of machine work. However, as it is impossible for any one man to learn them all, the next best thing to do is to put in the time in plants where the necessary work is being done. The thousands of useless things which the average operator (and the latter constitutes a majority) would be expected to learn in prosecuting a study of the subjects mentioned should be left to specialists.

The best engineer is the man who will put in from 8 to 15 years or over in high class power plants, who will leave "booze" alone, who will study and work, who keeps his eyes open and his tongue busy asking for information and puts the latter to the test when possible. However, to be a first-class operating engineer in everything that the name implies first quality brains are required.

CONCERNING AIR COMPRESSORS

By J. M.

I WISH to, through your columns, thank A. J. for his friendly criticism in the March issue of The Power House, of my statement in the February issue that "even with the best of oil it is good practice to use a little coal oil or soapy water on air compressor valves at times to prevent gumming;" to which he replied, "there is nothing more dangerous when put into an air compressor than coal oil except, perhaps, gasoline."

Now, nothing in my article implied or suggested the use of coal oil as a cylinder lubricant or otherwise except on the valves as above mentioned, therefore, I don't think there was any misunderstanding. Perhaps it is because my air compressor experience has been limited that I have never witnessed nor talked to any one who had witnessed an explosion in connection with air equipment, but I have occasionally read of such explosions and, without serious consideration, had assumed that they were the result of oil accumulations in pipe bends or in pockets and that proper oil and care would remove the cause. However, from what A. J. says it looks to me reasonable to believe that the coal oil practice can and may cause explosions and therefore is undesirable.

I consider his published correction especially valuable because I believe many engineers have at least one book which advises the use of "a small amount of coal oil at times," and, since comparatively few plants include an air compressor, the chances are that the majority of these men are unfamiliar with the care of this class of machinery, and that if called upon to operate same would at an early opportunity read up on the subject from their books and then use the coal oil because the book recommended it but did not add any remarks about danger. If A. J.'s correction prevents these men using coal oil and leads those now doing so to quit its use, he and The Power House may thus prevent possible future troubles.

I would now advise engineers not already familiar with this class of work to —if they have printed instructions advising the use of coal oil on air compressor valves—make on the margin of the page, a note of A. J.'s remark. It will then be on hand for use if needed, for you don't know when a future job may require this knowledge on your part, and it will keep better on paper than in the memory, that is, unless you can put it into practice at once.

A year's "sub" to The Power House and the making of a marginal note is vastly better than a bad habit in a power plant, not to speak of possible consequences.

* * *

Gas Heating for Tempering.—Gas is being used in France for heating tools of chrome-tungsten steel for the purpose of tempering them. The temperature required is 1,000 deg. Cent. (= 1,832 deg. Fah.), the tool being plunged in a bath of fused caustic soda. Any defects in the tempering tend to shorten the life of the tool, and with gas tempering the life of a tool is claimed to be longer than that of a similar tool tempered with a coke or oil fire.

POWER COMPANIES MERGER

THE organization of one of the most complete electric generating and distributing systems in the world was effected in Montreal, on June 7, when the consolidation was ratified by which the Civic Investment & Industrial Co., will take over the Montreal Light, Heat & Power Co., and the Cedar Rapids Mfg. & Power Co. Up to the present time altho controlled by the same interests, the two companies have been operated as separate units by different managements. By the consolidation, the Montreal Light, Heat and Power Co., with its extensive distributing system and its constantly increasing demand for electric power, will have available to meet its requirements and provide for the future an adequate supply of power at a low cost. On the other hand the Cedar Rapids Mfg. & Power Co., with its present installed capacity of 100,000 h.p. and an additional 60,000 h.p., which can be installed as required, will obtain a reliable market for its power through the advantages of the large distributing system owned by the Montreal Light, Heat & Power Co., on the Island of Montreal. The Civic Investment & Industrial Co., will have an authorized capital of $75,000,000.

It is understood that the new company will operate under the style and name of the Montreal Light, Heat & Power Co. The management of the Civic Investment and Industrial Co. will consist of the following officers: J. E. Aldred, New York, N.Y.; Sir H. Montague Allan, C.V.O.; George Caverhill, Montreal; Arthur V. Davis, Pittsburg, Pa.; Sir Rodolphe Forget, M.P.; Sir Herbert Holt, C. R. Hosmer, Hon. Robert Mackay, J. S. Norris, Hon, Narcisse Perodeau, Hon. H. B. Rainville, Montreal.

BOILER EFFICIENCY

IN a paper on "Some Aspects of Boiler Efficiency," read before the University of Illinois, it is stated that to secure proper combustion the design of the furnace and the manipulation of the fire are the leading factors. As an example of the effect an apparently insignificant variation would have, the author gave some data about a flat ignition arch for a chain-grate stoker burning Illinois screenings. In a certain installation the height of the arch from the grate was 11 in. Good ignition could not be secured, so the arch was raised to 13 in. A great improvement was at once evident, and in the hops of doing still better the arch was made higher, being raised to 15 in. The ignition proved to be again poor, and the fire was not getting a start at the feed grate as it should. In this case 2 in. either way was detrimental to combustion.

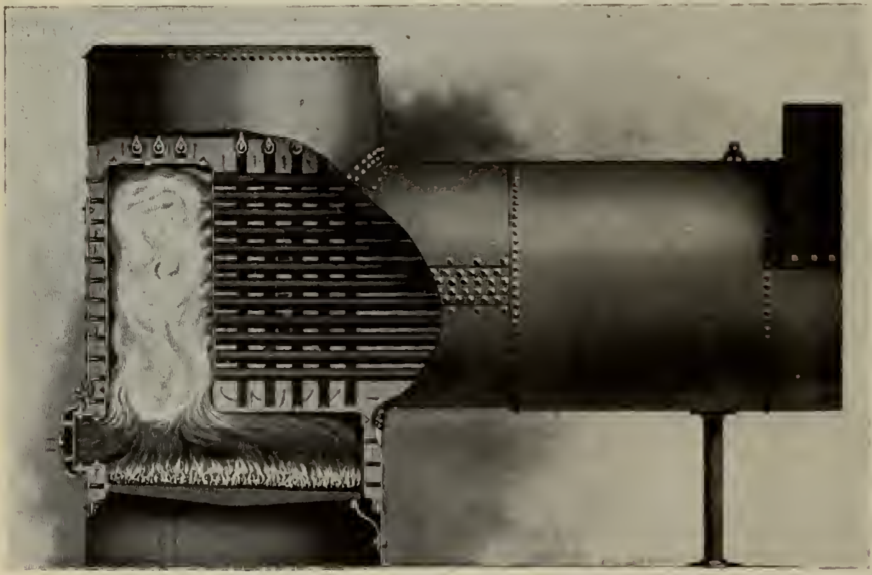
Operators' Instruction Course

THE STEAM BOILER—VI.

NO boiler can maintain its efficiency unless it is kept clean both inside and out. Deposits of solid matter on the water side of the heating surface interfere with the heat transmission, and cause the metal to burn, blister, or crack, thereby greatly increasing the repair and fuel bills. Systematic boiler cleaning should therefore be included as a regular feature of the operation of every steam plant, irrespective of the type of boiler installed.

Care and Management

A boiler should never be emptied while the brickwork is hot, for if this be done there will be danger of overheating the metal, and the incrustation will bake to such hardness as greatly to increase the difficulty and expense of removing it. The best procedure is to allow the boiler to stand at least twelve hours, and more if possible, after the fires are drawn, then to empty it slowly; the manhole doors being next removed.



ILLUSTRATING COMBUSTION AND CIRCULATION IN VERTICAL MARINE TYPE "FITZGIBBON" BOILER.

If the circumstances are such as to require more immediate action, allow the boiler to stand three or four hours only, after the fires are drawn and the main stop valve is closed. The pressure should then be let off, the blow-off valves be opened slightly and water be pumped in at the same rate as it is escaping from the blow-off, which can be done by regulating the pump to the speed necessary to hold the water at the same level in the gauge glass. Pumping should be continued until the boiler is cooled to a temperature low enough to permit it to be opened.

To hasten the cooling of the boiler it is not unusual to open the fire and ashpit doors also the damper, thus causing a rush of cold air through the setting. While this assists in the cooling, it is an unsuspected cause of the destruction of many furnace walls. A rush of cold air over highly heated fire-brick causes a rapid cooling of exposed surfaces, uneven shrinkage, and cracking or "spalling" of the brick and loosening of the joints. The degree to which these evil effects are caused by cold air is not generally recognized, and it is advisable never to throw open the damper and draft- doors until about four hours after the fires are drawn.

Before starting to remove a manhole door, the operator should, by trying the gauge cocks, or by opening the valve on the steam hose connection, definitely ascertain that there is neither steam pressure nor a vacuum inside of the boiler. A disregard of this simple precaution has been responsible for many serious accidents to those engaged in cleaning boilers.

Precipitation and Scale

Practically all waters available for boiler feeding contain some impurities which deposit either as mud or as scale. When mud is present it is nearly always precipitated, whence it should be blown out at regular intervals which must be determined by close observation in each case.

Scale varies from a porous texture which adheres loosely to the metal, to a hard flinty structure which can be removed only by chiseling or cutting it. Its removal is often tedious but the task should never be slighted. Various ways of removing scale have been tried, but experience shows that the most satisfactory method is to use some mechanical device, operated by power, and so designed as to cut or break the scale. Such devices may be divided into two classes: (1)—Those which, by very rapid hammer blows, detach the scale by cracking it; (2)—those which, after the manner of an emery wheel dresser, cut the scale into small pieces. Each of these find their scope more particularly in scale removal from boiler tubes, the latter being either of the water or smoke tube types.

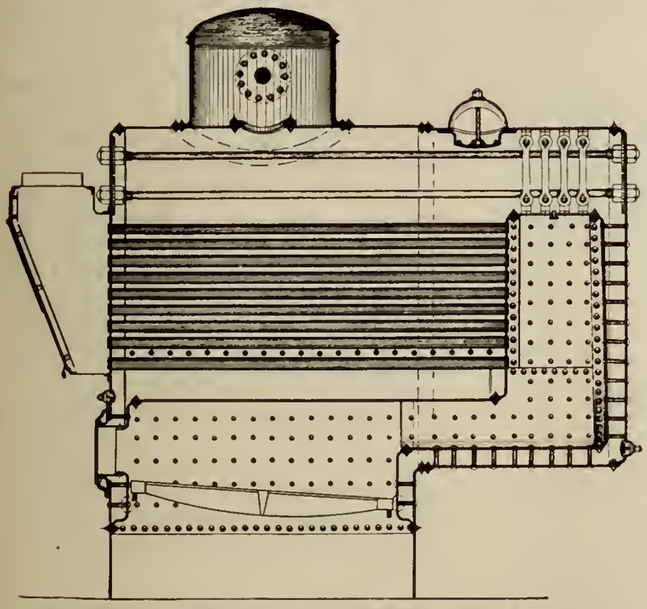
Softening Refractory Scale

When scale has been allowed to accumulate and take on an excessive hardness, its removal is difficult. The work may however be expedited by introduction of some agent which will rot and soften the scale. One method is to introduce from 40 to 80 pounds of carbonate of soda (soda ash), according to size of boiler, the procedure being to block the safety valves open, and allow the water to simmer gently. In specially bad cases this may have to continue several days. The scale will, however, be softened so as to be more easily disintegrated. Clean fresh water should be used to rinse out the boiler before starting-up for steam making, otherwise foaming may result.

Kerosene is used often for softening scale, the methods of its application being varied. Some spray it over the scaled surfaces with a squirt pump or similar device, while others fill the boiler nearly full of water, introduce the kerosene, then open the blow-off very slightly, by which means the kerosene comes into contact with the entire interior surfaces. Following this before anyone enters the boiler, the latter should be thoroughly ventilated to remove volatile gases from the oil, since they are highly explosive. Kerosene should never be used without first testing it for free acid which is liable to be present from the refining. Insert blue litmus paper, and if it turns red the oil should be rejected since the acid will cause corrosion.

Oil in Boilers

Scale is not the only cause of burned tubes and plates. Burnt and blistered tubes and plates will be the inevitable result of allowing oil to enter boilers. When the presence of oil is detected, the boiler should at once be cut out of service, and as soon as it has cooled it should be emptied, and several pailfuls of soda-ash be placed inside. The boiler should then be filled with water, and be gently fired for 12 to 15 hours, keeping the steam pressure down to 12 or 15 pounds. At intervals, a portion of the water may be let out, and be replaced by pumping in an equivalent amount; finally the boiler should be allowed to cool, then be emptied and the interior thoroughly rinsed with fresh water.



SECTIONAL VIEW OF "FITZGIBBON" HIGH PRESSURE HORIZONTAL MARINE TYPE BOILER.

Fire Side of Heating Surfaces

The fire side of the heating surface should be kept clean, and under no circumstances should a thickness of soot exceeding 1-16 of an inch be allowed to form, or the boiler efficiency will be greatly decreased. The surface or interior, as the case may be, of the tubes, etc., should be regularly blown off with steam by using the hose and steam blower-pipe, and since the heating surface can be blown off in 10 to 15 minutes, there is no reason for neglecting this work. The interval between such cleanings will depend upon the character of the fuel. With smoky fuels, the cleaning should be done at least once per day, preferably during the period of lightest load; the surface should also be well brushed off at regular intervals.

The steam-blower should not be used when the boiler is cold, or the steam will condense, dampen the brickwork, and cause the sooty deposits to become gummy and adhere to the metal. It is advisable to have not less than 50 lbs. pressure on the boiler when the steam-blower is used, and there should be a fire on the grates to insure the brickwork being hot.

Periodical Examinations

No matter how excellent the feed-water may appear to be, every boiler should at regular intervals be examined. In water tube boilers, the mud drum should be inspected regularly, and all accumulation of soot, ashes, or dirt, be thoroughly removed. In all cases where coal, particularly anthracite, is used, the accumulations on the mud drum should be blown off before the boiler is emptied. The reason for this is that such deposits often contain coal which holds fire for many hours after the furnace fires are drawn, and the heat due to this cause may damage the drum or tube ends if the boiler is emptied.

All soot, ashes and dirt should be removed from the top of furnace arches every time the boiler is cleaned. The top of the bridge wall should be swept clean, and any defects in the brickwork should be repaired. The opening where the blow-off pipe passes through the wall should be inspected, and if air leaks are found they should be stopped by caulking with asbestos rope. All cleaning doors should be examined, and if air leaks are detected they should be stopped.

Whenever a boiler is off for cleaning it is an excellent plan to make a careful general inspection of it both inside and out, including the setting, cleaning doors, valves fittings, etc., Incipient defects may thus be discovered and corrected at a trifling expense, serious troubles will be obviated, and the general operation of the plant will be improved. It is doubtful whether the short time necessary for such inspection could be more profitably employed, since a boiler plant continually proves the truth of the ancient maxim, "A stitch in time saves nine."

Starting-Up A New Boiler

Make a complete examination of boiler and setting. Inspect all valves, fittings and attachments, and ascertain that they are properly connected and in perfect order. See that nuts on all tie rods in frame are turned up tight, and at intervals during the first six months after the boiler is in operation, ascertain if these nuts are tight, and if not, make them so.

Inspect the brickwork, and see that height of fire-arches and distance between end of fire-arches and nearest tube corresponds with drawings. In water tube boilers, see that the mud drum can expand freely; that baffle openings are as marked on drawings, baffle tiles all in place and joints sealed with fire clay, and that all mortar and rubbish which has dropped down on the mud drum while brickwork was in progress, has been scraped off and drum surface brushed clean. This is frequently overlooked. See that blow-off pipe and valve, as well as blow-off main to which they are connected, can move freely; on no account should they be cemented or bricked in, but should lie free in a trench or slot. See that space around the blow-off pipe where it passes through rear setting wall is plugged with asbestos rope until it is air-tight.

Oil or Gas Fuel

When oil or gas fuel is used, take particular care to ascertain if the fire arches terminate at proper distance from the tubes; checkerwork walls in rear of grates are of proper height; openings between brick over grates are of proper width, and burners set to blow the flame parallel to the brick over grates and at proper distance above them. To minimize effect of gas explosions, turn back the latches of cleaning doors, so the doors can blow open freely and release the pressure due to the explosion.

See that all dirt, waste, and tools, are removed from interior of boiler. Then place in same about a peck of soda-ash, fill to usual level with water, boil gently for several hours after boiler is finally heated up, let stand till cold, then empty, and finally give interior of boiler a thorough washing with cold water. This will remove all oil and grease and prevent foaming when the boiler goes into commission.

◆

Some machine men run belts entirely too tight, causing a large increase in friction in the bearings, thereby consuming extra power.

Question and Answer Series

Question.—In transforming a rotary motion to a reciprocating motion, with a crank 12 inches long and a connecting rod 4 feet long, what would be the position of the crank pin when the cross-head is in the middle of the stroke, and also the angle formed by the connecting rod and the centre of motion?

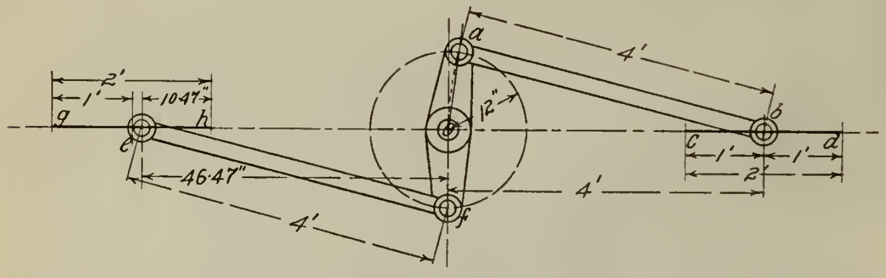
Answer.—With (o) as the centre of rotation, the distance to the centre of cross-head slide (c-d) will be equal to the length of the connecting rod, or 4 feet; therefore, when the cross-head is in the middle of its stroke the crank pin will be in the position shown at (a), or the intersection of the arc a o with the crank pin circle. Then the triangle a b o will be an isosceles triangle with two legs of a length equal to the length of the connecting rod, or 4 feet. To find the angle formed by the rod and centre of motion use the formula

$$\text{sine} = \frac{\text{side opposite}}{\text{hypotenuse}} = \frac{6}{48} = .12500, \text{ then}$$

angle corresponding equals 7 degrees 11 minutes; therefore, the angle required will be twice this, or 14 degrees 22 minutes. If the crank is midway between the front and rear dead centres, then the cross-head will be closer to the crank end of the slide. To find its true position graphically proceed as follows: With the crank in the position f, a trammel of 4 feet will cut the centre line of slide at the point e. To find this point by calculation, as the lengths e f and o f are known, we find the distance e o by the formula $\sqrt{[(e\,f)^2-(o\,f)^2]}=\sqrt{(48^2-12)^2}=\sqrt{2160}=46.47$ inches; then, as the distance o b is 36 inches, the distance h e will be $46.47-36=10.47$ inches, and the angle o e f will be found from

$$\text{the formula: } \text{sine} = \frac{\text{side opposite}}{\text{hypotenuse}} = \frac{12}{48}$$

$= .25000$, and angle equals 14 degrees 29 minutes.



Question.—In a ball governor when in operation on a steam engine, what are the opposing forces at work?

Answer. — Centrifugal force due to the revolving of the balls, which tends to make them pull apart from their pivot, and the force of gravity which tends to keep them in the position occupied when the governor and engine are at rest.

* * *

Question.—What purpose does a fly-wheel serve outside of its utility for a belt, rope or chain drive, when attached to the crank shaft of a steam engine?

Answer.—It stores up the energy developed in the engine cylinder up to the point of cut-off, and gives same out again during expansion, thereby enabling the engine to maintain a steady and uniform speed, and contributing to the absence of jar when the crank is passing the centres.

* * *

Question.—What precautions should be taken to prevent accidents from bursting water gauge glasses?

Answer—To prevent avoidable accidents from bursting gauge glasses they should be of good quality, and the fittings should be in line. When putting in a glass it should be placed in the recess of the bottom fittings and the gland screwed up; then, after it is secured in the top fitting in a similar way, it should be possible to turn the glass by hand. The systematic renewal of gauge glasses every six months or so, instead of waiting until they break is very good practice.

* * *

Question.—Explain the action of an injector, when feeding a boiler.

Answer.—At first sight, the action of an injector seems to be a paradox, since water is delivered into the boiler against a pressure equal to or greater than that of the steam operating the injector. The explanation is as follows. The velocity of an issuing jet of steam is many times greater than that of a jet of water issuing under the same pressure, and, if steam, while issuing from a boiler, be condensed, but not reduced in velocity to that of water issuing under the same pressure, it is then capable of overcoming the pressure of the water in its own boiler. This is exactly what takes place in the injector. The steam on entering, passes through the cones and is condensed on coming into contact with the feed water, without losing its velocity, further than that due to friction in the passages. The vacuum formed by the condensation of the steam causes more water to flow into the injector, and this feed water is carried on by the force of the condensed steam jet into the boiler. The velocity of the steam jet is much reduced by imparting a high velocity to the feed water, but as it is not reduced nearly so low as that of a jet of water issuing under the same pressure, sufficient momentum is imparted to the feed water to lift the boiler check valve.

* * *

Question.—On completing the installation of a new ice plant equipment, what is the usual procedure to be followed in testing out same before it goes into operation.

Answer.—The usual test pressures for high and low sides are 350 and 50 pounds per square inch of air respectively. The pressure should be pumped up by stages, stopping intervals between being in order for cooling down purposes. Once the total pressure is reached, the system should be allowed to cool down entirely before a pressure drop indicates a leak somewhere. Water should be run over the condenser for cooling down. All joints should be soaped to aid in locating leaks, and supplementary to this about an ounce of oil of peppermint should be injected into the system. Pull a vacuum on the suction side and note if it holds, after which follow with a second pressure test. All air should be pumped out of the system before charging with ammonia.

* * *

Question.—In a steam power plant with reciprocating engines and surface condensers installed, it of course becomes necessary to furnish "make-up" water for boiler feed, due to unavoidable losses from leakage, etc., throughout the system. Should the "make-up" be delivered direct into the condenser or into the air pump hot-well-

Answer.—The make-up water should be delivered to surge tanks that supply the heaters, or to a hot-well into which the condensate is discharged, to be pumped later into heaters, or if heaters are not used, to be pumped directly into the boilers. No advantage is gained by discharging water into the surface condenser rather otherwise since the main object is to pump the water obtained from the condensed steam out of the condenser. The disadvantage of putting "make-up" water into the condenser is that the air pumps are required to handle the air admitted with the water and to do the additional work of pumping the "make-up" water out of the condenser against a vacuum. Should the make-up required be 10 per cent., it would mean that the condensate pump would have to do 10 per cent. more work in order to remove this water from the condenser and discharge it into the hot-well. Furthermore, when make-up water is admitted to the condenser shell it is difficult to provide satisfactory means of controlling the amount so admitted, a problem not presented when the water is put into the hot-well or a heater.

* * *

Question.—What is the function of a fusible plug as fitted to steam boiler furnaces and fireboxes; of what does it consist, and how does it accomplish its purpose?

Answer.—Fusible plugs provide a valuable safeguard against serious explosions and collapse of furnace crowns due to low water. They should be fitted directly over the fire in all straight furnaces and in the crowns of all fire-boxes. A fusible plug consists of a metal cone, as small as practicable, held in position in a conical cap by an alloy ring of low melting point. Should the crown of the furnace become overheated through want of water, the alloy melts before there is any serious danger, the cone drops, and the escaping steam puts out the fire. Fusible plugs are not reliable unless they are kept perfectly clean on both sides. They should be examined at each cleaning time, and the fusible metal renewed periodically. One leading railway company makes a practice of renewing, monthly, the fusible metal of the plugs in the fire-box crowns of their locomotive boilers, while insurance companies dealing with stationary boilers recommend renewal at intervals, varying from one to two years, depending on the nature of the feed water and other local circumstances. Most types of plugs are now fitted with a cap that can be easily renewed, therefore a number of spare caps should be kept to prevent delay in the event of a plug melting.

* * *

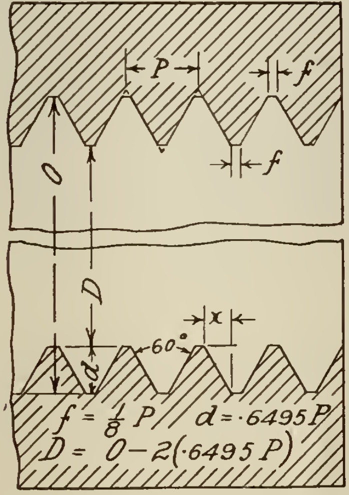
Question.—Are some brushes designed to operate with the commutator running towards the "toe" instead of towards the "heel?"

Answer.—Yes; differences in practice in this regard are due to differences in mechanical conditions. Brushes vibrate less in some cases when the direction of the inclination of the brush with respect to the direction of rotation is changed.

* * *

Question.—Without the use of a table how can the bore of a hole be calculated for the standard United States thread?

Answer.—As shown in the sketch, the flat on the top and bottom of the thread is equal to ⅛ of the pitch; therefore, the distance x will equal the pitch minus twice the flat or ¼ of the pitch. Then to find the depth use the formula, side adjacent = cotangent× side opposite, or $1.73205 \times \frac{3}{8}P$; for example, to find the bore for a 4-inch diameter, 3-thread U. S. screw. The depth would be $1.73205 \times \frac{3}{8}P$, or $1.73205 \times \frac{3}{8} \times .333 = .2163$ inch. Then bore would be $4 - (.2163 \times 2) = 3.5674$ inches. From the above a formula may be derived which will simplify the operation, thus—$1.73205 \times \frac{3}{8}P = .64952P$, which multiplied by two will give the total amount to be deducted from the diameter of the bolt or male thread.



* * *

Question.—With a belt speed of 380 feet per minute on a 9-inch cone pulley, and a gear ratio of 8 to 1 between the cone and the spindle, what time would be required to travel over a 9¼-inch diameter shaft, 27 inches long, with 1-16-inch feed; and what would be the cutting speed in feed per minute?

Answer.—With a belt speed of 380 feet per minute the speed of the cone pulleys would be 380 divided by the circumference of the pulley in feet or $380 \div (\frac{9}{12} \times 3.1416) = 118.8$ rev. per min.

With a gear ratio of 8 to 1 the speed of work or lathe spindle would be $118.8 \div 8 = 14.85$ revolutions per min. The cutting speed would be number of revolutions multiplied by the circumference, or $14.85 \times \frac{9.25 \times 3.1416}{12} = 35.9$ ft. per minute.

Time required to travel over 27 inches of shaft will be the length divided by the feed, and again divided by the revolutions, or $\frac{27 \div 1\text{-}16}{14.85} = \frac{27 \times 16}{14.85} = 29.09$ min., practically one-half hour.

* * *

Question.—(a) Are alternating current motors built for 220 volts at 500 horsepower rating? (b) Are steam turbo-generators of 2,000 k.v.a., 3-phase, 60-cycle capacity built for as low a voltage as 220 volts? If so, what is the relative cost of such a unit? (c) Would it be cheaper to generate at 2,200 volts and step down to 220 than to purchase the low-voltage generator?

Answer.—(a) There is little or no demand for motors as large as 500 horsepower for voltages as low as 220. (b) Turbo-generators of 2,000 k.v.a., 60-cycle, 220 volt, 3,600 r.p.m., have been built for special applications, usually for supplying low-voltage rotary converters. The cost of the low-voltage generator will be a little higher than a similar 2,400 volt generator on account of the cost of the heavy copper armature cross connecting straps and leads, but this difference will not begin to pay for the transformers. (c) A 2,400 volt generator and step-down transformers would be the best scheme if the current must be transmitted more than 100 feet from the generator.

* * *

Question.—With a tensile strength of 60,000 lbs. per sq. inch. and a factor of safety of 5, what would be the limit of load on a ⅝ rod?

Answer.—With the above safety factor of 5, the limit of load would be 60,000 lbs. divided by 5, or 12,000 lbs. per sq. inch. For a ⅝ rod this would represent a load of $12{,}000 \times \frac{5}{8}^2 \times .7854 = 3684$ pounds.

* * *

Question.—What is the difference between the terms stress and strain?

Answer.—Stress is that force within a body which resists the action of an externally applied force; while the strain is the deformation, or change of shape, produced by the applied force, and is proportional to the stress within the elastic limit.

Steam Power Plant Auxiliaries

FEED WATER HEATERS—I.

THE economy in operating expense which can be effected through the use of feed-water heaters is so great that few plants of any size are now erected in which heaters are not installed. Apart from fuel economy, the evil effects on a boiler structure resulting from the feeding of cold water are so serious that a feed-water heater may be justified on that account alone. The most important benefit, of course, and one which makes the most direct appeal is the saving of fuel, which is brought about by the use of exhaust steam.

With an initial temperature of 65 degs. Fahr. and a final temperature of 200 degs., which is easily obtainable with any modern apparatus using exhaust steam at atmospheric pressure, there is a saving of about 12 per cent. in fuel, and it may be assumed generally that every 11 degs. that feed-water is heated by exhaust steam means a saving of 1 per cent of fuel.

An exhaust steam feed-water heater possesses an advantage in fuel-saving over injectors or live-steam apparatus, because these latter draw live steam from the boiler, and an exhaust heater makes use of a product which has already done useful work.

Types of Heaters

Two general types of heaters are in use—the open and the closed, the selection of either type being occasionally influenced by local conditions, such as condensing or non-condensing engines, existing filtering and purifying equipment, quality of feed-water, and proportion of steam available for heating purposes.

Where exhaust steam is available in sufficient quantity the open type heater can be used to advantage, as the temperature attainable in closed heaters is not so high for the same amount of steam, due to the fact that in the closed type the heat has to pass through the metal separating the steam from the water.

Open type heaters consist of a square box-like chamber divided into suitable compartments, containing various parts of the apparatus. The upper portion contains a series of trays, over which the cold feed water passes while falling from the top to the bottom of the heater. Some types have an additional connection through which the hot discharge from steam traps, reheaters, engine drains, heating systems, etc., can be added to the contents of the heater. The water level in the heater is maintained at the required height by a suitable float valve, and a similar valve controls the overflow, preventing the level from rising too high should the pump be at rest for an extended period and the heater continue to receive drip water, etc.

Removing Soluble Impurities

When the feed water contains scale forming salts which are precipitated at temperatures lower than 200 degs. Fah., the traps receive this deposit, being removed through access doors for periodical cleaning. Matter in suspension which is not separated by heating is removed from the water by means of a filter containing coke or some similar mechanical medium, while in some cases chemical purifiers are combined with the heater, completely removing such scale-forming impurities as are not disengaged and separated by the previous action of the heater.

Closed Type Heaters

Closed type feed-water heaters are generally constructed with a cylindrical shell, the closed ends of which are connected with tubes or pipe coils of various shapes and sizes. End covers enclose the tubes and carry connections to admit either steam or water to the inside of the tubes as may be called for in the design. When the feed-water passes through the tubes and the steam is admitted to the shell, the heater is known as being of the water tube type. When conditions are reversed and the steam flows through the tubes, the heater is said to be of the steam tube type.

Necessity for Oil Separation

Owing to the fact that the exhaust steam and water are mixed together in open heaters, it is absolutely necessary that oil and grease carried over from the engine be completely removed before the steam enters the heater; otherwise these substances are liable to be returned to the boiler along with the feed water, giving rise ultimately to trouble. Closed heaters avoid this trouble altogether, because the steam and suspended oil particles never come in contact with the feed-water, although in some cases the drain from closed heaters may be connected to the hot well in the case of condensing engines, in which event a feed water filter would be necessary to remove the oil before the water was returned to the boiler.

For this reason, oil separators are an important part of all open heaters, while the lack of a separator on a closed heater would detract still further from the efficiency of the latter type, as the presence of a thin film of oil on the tubes would add to the loss of heat during transmission from one side of the tube to the other. Oil separators therefore are nearly always used with exhaust heaters, and generally form a component part of the apparatus.

Manner of Connection

Both open and closed heaters may be connected to the exhaust pipe in a variety of ways, which apply equally to both types. The "thoroughfare" method in which all of the steam passes through the heater makes it necessary for the oil separator to remove all of the oil carried over in the exhaust. On the other hand a single connection may be made to the main exhaust pipe and the vacuum formed in the heater may be relied on to induce a flow of steam into it.

These methods only apply of course to non-condensing plants. Where a condensing plant is working under a vacuum of say 26 in. the exhaust steam temperature would be betwen 120 and 130 degs. with a condenser discharge temperature of about 100 degs. In this case modern practice frequently calls for steam-driven auxiliaries and their exhaust steam, after performing useful work in air pumps, feed-pumps, etc., can be used in an exhaust heater of suitable type, raising the feed-water temperature from about 70 degs. to over 200 degs. Should sufficient exhaust steam be not available from the auxiliaries, a closed type heater may be inserted in the main exhaust pipe and a temperature of over 100 degs. obtained in the feed-water before it is passed into the final heater. Modern plants, however, have the proportion of their various units balanced so that this latter arrangement is not of frequent occurrence.

"Webster" Feed-Water Heater and Purifier

This apparatus is built by Darling Brothers of Montreal in a number of types adaptable to a large variety of conditions, different types being illustrated in Figs. 1 to 3.

Fig. 1 is a cut away view showing part of the exterior and interior of a Class "EC" heater which is built in a range of sizes from 500 to 10,000 horsepower. The steam supply enters through the large flange connection on the upper part of the heater at the left, the plates immediately behind the opening being the baffles of a "Webster" oil separator which form part of the heater construction. The operating principle is a combination of centrifugal force, impact and adhesion of the entrained oil against the vertical steel baffles, one edge of which is curled back against the flow of steam so that the particles of oil in the steam are arrested in their flight, falling by gravity into the receiving well and thence to waste through a drain pipe. The two latter items can be observed in the illustration, the drain pipe being fitted with a check valve and globe valve.

The steam supply is drawn into the "Webster" heater through a branch from the main exhaust pipe with a gate valve in it, which obviates the difficulty attendant upon taking all of the exhaust steam with its entrained oil through the heater.

The feed water enters through a float controlled valve on top, the connecting rod to adjustable counterweight and float being shown at the right of the heater. A waterseal distributing-trough receives the feed-water from the inlet pipe, the purpose of the water seal device being to prevent any back pressure steam which might accumulate from entering the cold water supply and causing water hammer.

Overflowing from the trough in an even sheet, the water is distributed over a series of oppositely inclined, finely perforated copper trays, arranged one above the other as shown in the illustration, so that the water in its downward course falls from one tray to the other, and any water which does not pass through the perforations will fall upon the projecting upper edge of the next tray. This arrangement maintains the water in a finely divided state while in the heating chamber allowing it to mingle with and be thoroughly heated by the surrounding steam, with a consequent liberation of gases and precipitation of solids.

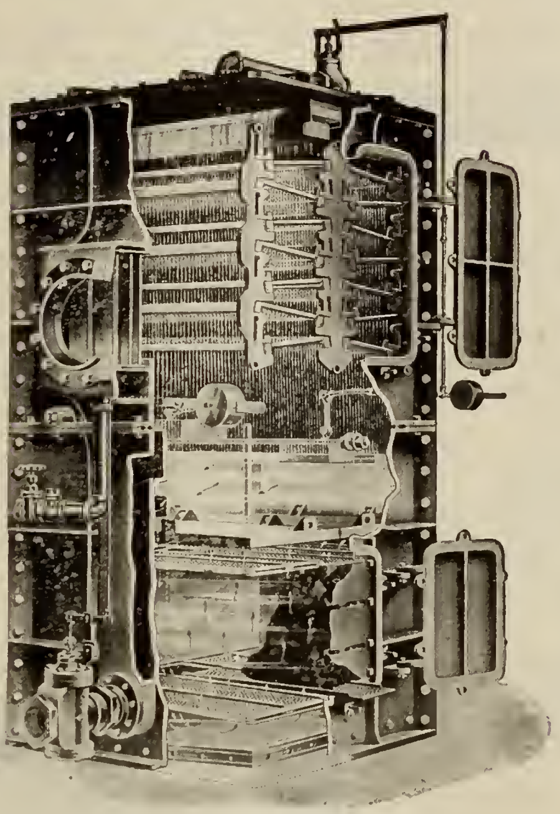


FIG. 1. "WEBSTER" FEED WATER HEATER AND PURIFIER, 500 TO 10,000 H.P.

The lower part of the heater provides storage capacity and also space for the filter. Between the level at which the float closes the cold water supply valve and the level of the overflow, there is ample space for the accumulation of condensation from heating systems, dry kilns, etc. Any dangerous excess of water automatically passes out of the heater when the water reaches a high level, the float valve which controls this being normally closed to prevent loss of steam.

The filter, as shown in Fig. 1, extends across the full width of the heater and close up to the front wall. The water falling from the trays passed down around the back, and underneath the filter, rising upwards through the filtering medium till it reaches the outlet to feed-pump.

Access to trays and filter is had through the hinged doors which are shown open, a section of the filter door being partly withdrawn. A quick-opening drain valve is provided at the lowest part of the bottom, through which the heavier sediment and impurities may be withdrawn from the settling chamber. The light, floating surface impurities are removed by a suitable skimmer, passing into the waste pipe with the overflow through the automatic valve.

For waters that contain incrustating materials not disengaged or separated at exhaust steam temperatures, or by filtration of feed water thus heated a special type of apparatus is built by this firm, in which the feed-water with-

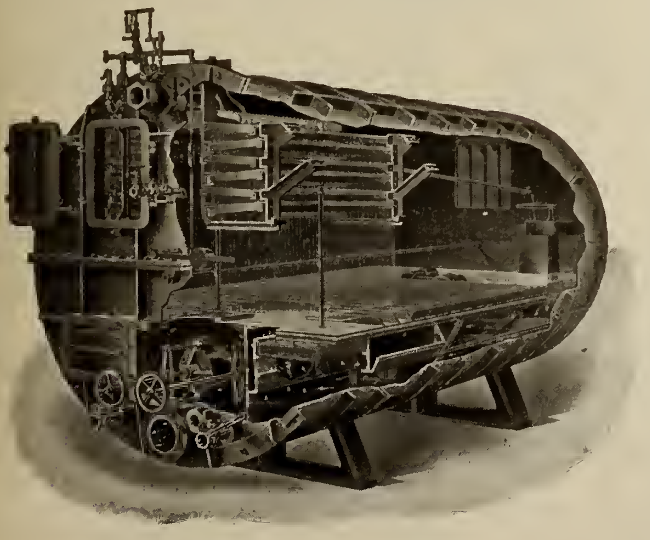


FIG. 2. "WEBSTER" FEED WATER HEATER AND CHEMICAL PURIFIER, 500 TO 5,000 H.P.

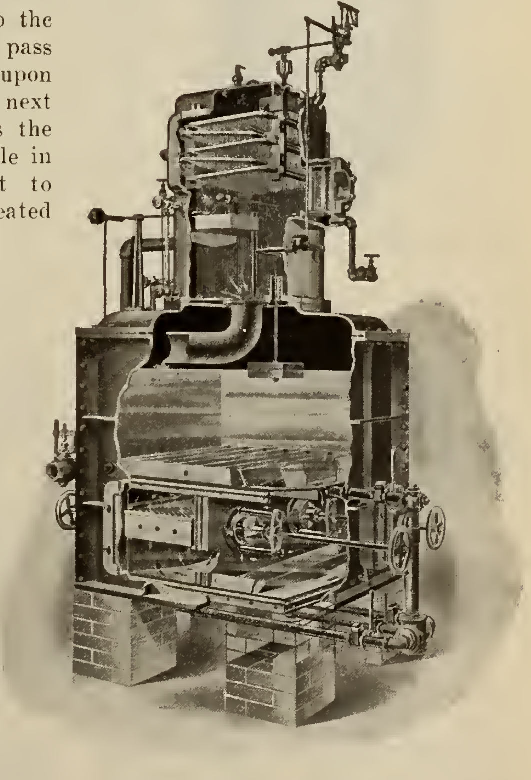


FIG. 3. "WEBSTER" FEED WATER HEATER AND CHEMICAL PURIFIER, 50 TO 300 H.P.

in the heater can be treated while hot, by the proper chemicals to separate and remove such scale-forming impurities before the feed-water is pumped into the boilers. This apparatus is known as the "Webster" Feed-Water Heater and Chemical Purifier and is illustrated in Figs. 2 and 3, the latter showing class EC built in sizes from 50 to 300 horse-power, and the former, class E D from 500 to 5,000 horse-power.

These are somewhat similar in appearance to the apparatus shown in Fig. 1, except in the case of the largest size which is built in the form of a horizontal cylinder. The internal arrangements are identical in principle, the cold water entering at the top, descending over the trays and subsequently passing through chambers containing purifying chemicals.

Reilly Multicoil Heater

A modern example of a closed heater of the water-tube type is found in the "Reilly" heater, which is the product of the Canadian Griscom-Russell Co., Montreal. As indicated, the water is inside the coils and the steam in the shell. Close-grained cast iron is the material of which the shell, manifold and heads are made, the heating surface being formed of pure copper tubing of relatively small diameter arranged in numerous vertical coils, which are connected to the top and bottom distributing headers by screwed union joints. These coils are all made to standard dimensions and are detachable and interchangeable, access to the interior of the shell being had through a door shown in illustration Fig. 4.

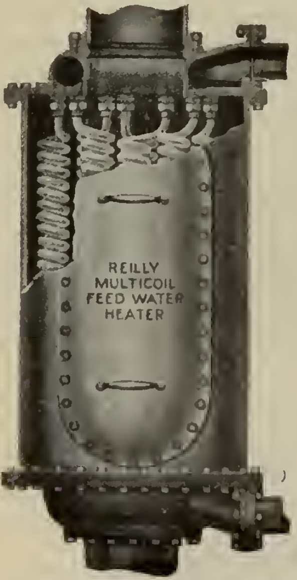


FIG. 4. REILLY MULTI-COIL HEATER.

The elasticity of construction obtained through the use of coiled copper tubes avoids undue strains due to variation in temperature of the different parts, while in the case of accident or wrong usage, the entire coil units can be renewed without disconnecting either steam or water piping, in addition to which, type C heaters are provided with separate manifolds which permit wide variation in position of water connections in stock units.

The rapid swirling flow of water through the coils maintains it in constant agitation, resulting in remarkably high efficiency. Unusually large space is provided for the passage of steam, which eliminates the possibility of additional back pressure being put upon the engine.

This heater may be placed in a horizontal as well as a vertical position, and can be connected up either as a through heater or an induction heater. In the through system, the steam passes completely through the heater and then through the back pressure valve, the steam entering at top or bottom as desired. In the induction system the heater is closed on either top or bottom, and the other end is connected to the exhaust steam main, which has an atmospheric branch pipe with back pressure valve. This arrangement causes the heater to float on the end of the exhaust pipe, drawing more or less steam into the shell according to the temperature imparted to the coils by the incoming feed-water.

◆

AUTOMATIC FEED WATER REGULATOR

THE Foster automatic feed water regulator is designed to regulate and automatically control the admission of feed water to steam boilers. The apparatus has been designed so as to possess the fewest possible number of parts, and is applicable to large or small, single or multiple, battery installations.

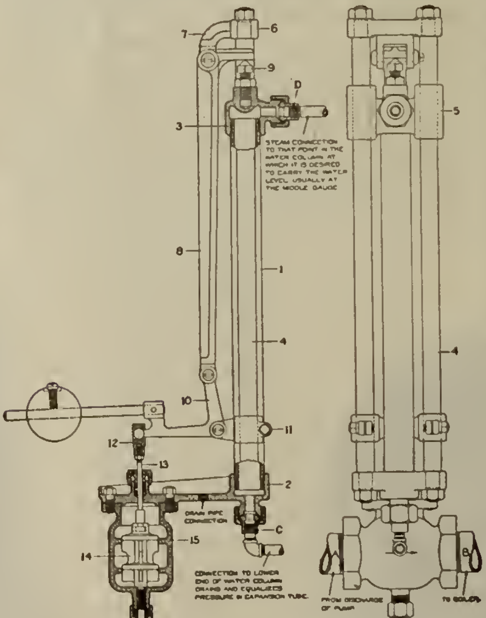

7
6
9
D
3
5
STEAM CONNECTION TO THAT POINT IN THE WATER COLUMN AT WHICH IT IS DESIRED TO CARRY THE WATER LEVEL USUALLY AT THE MIDDLE GAUGE
8
1
4
4
10
11
12
13
2
DRAIN PIPE CONNECTION
C
15
14
CONNECTION TO LOWER END OF WATER COLUMN DRAINS AND EQUALIZES PRESSURE IN EXPANSION TUBE
16
FROM DISCHARGE OF PUMP
TO BOILER

FIG. I. EXTERNAL VIEW AND DETAILS OF CONSTRUCTION OF FEED WATER REGULATOR.

Details of construction are shown in Fig. 1, and manner of installation in Fig. 2. The actuating principle of the device is the change in length of the expansion tube 1, its upper end carrying the cross-head 5, which is free to slide on columns 4. Normally, the water in the boiler or water column seals the end of the pipe leading to the top of the expansion tube, so that steam is excluded therefrom, and the tube cools and contracts. This allows the short upper arm of bell crank 8 to descend so that the counterweight on the lower bell crank 10 may close the valve in the feed pipe.

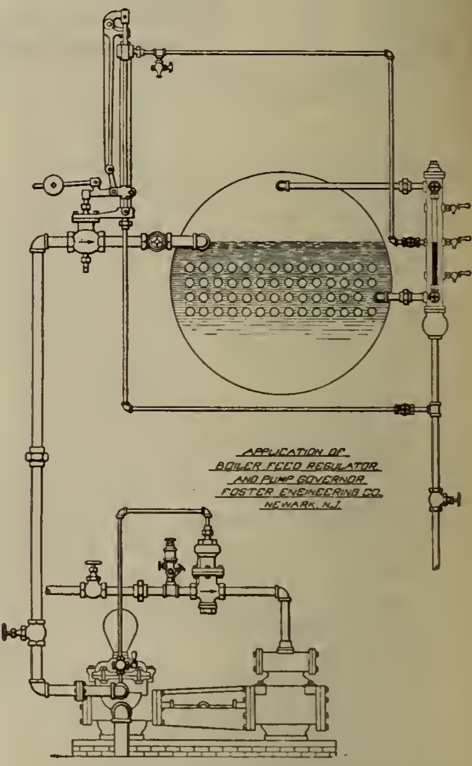


FIG. 2. APPLICATION OF REGULATOR TO BOILER.

When the water recedes below the desired level, steam enters the top of the expansion tube and the increased temperature causes it to expand, reversing the action of the two bell cranks and opening the valve in the feed pipe. Adjusting screw 9 on the top of the expansion tube permits the apparatus to be set for any desired variation.

The device is manufactured by the Foster Engineering Co., Newark, N.J.

◆

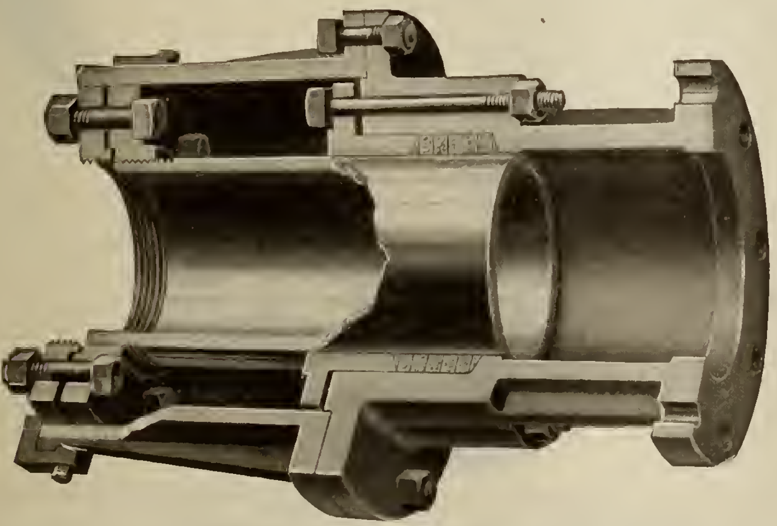
A saw belted direct from a 7 horse-power motor, would not rip anything. A 10 horse-power motor was put in, but the machine still refused to work. It was a large self-feed saw, with pulley on arbor for an 8-inch belt. A 7-inch belt was being used. To save the motor, the 7-inch belt was taken off and replaced by a 4-inch one. The saw now works well. The motor would not stand the sudden jerks sent to it by the wide belt, while the narrow belt gives and thus prevents the shock.

Progress in New Equipment

CROSSHEAD-GUIDED EXPANSION JOINT

THE illustration shows a sectional view of the Ross crosshead-guided expansion joint, which is so named because of a prominent constructional feature. It is made by the Ross Heater & Mfg. Co., Buffalo, in standard sizes and suitable for pressure up to 200 lb. per sq. in., and for pipes up to 24 in. diameter.

The joint is formed of two members which slide one within the other, the outer one being made in two parts, which are bolted together at the outside circumferential joint near the centre, while the inner member is composed of a sleeve, one end of which passes through the gland and stuffing box formed in one part of the outer member, while the other end is supported by companion flanges as shown. These flanges are accurately machined on the diameter so as to slide smoothly and freely in the bore of the outer member or guide, the action of the inner member being precisely that of a trunk piston with a cylindrical crosshead.



CROSSHEAD-GUIDED EXPANSION JOINT.

The desirable support thus given to the crosshead flanges keeps the sleeve in proper alignment with the outer member, and prevents sagging strains from destroying the packing and causing other excessive tear and wear. Access to the stuffing box is readily obtained by removing the bolts on the guide flange and sliding the casing back. Any kind of metallic or fibrous packing can be used in the packing space to form a steam-tight joint that requires little or no attention. Occasional drawing up of the packing gland can be done from the outside by means of the long bolts shown.

As the inner area of the slipping section is equal to the area of the pipe, a state of balance is obtained in the joint which relieves the stress that would otherwise occur. Joints intended for use at points where elbows or tees for branch lines are located have anchorage footings cast on to give the required support to vertical pipes and fittings.

MAMMOTH CONVEYOR BELT

CONFRONTING a sugar refining company some ten years ago was the problem of catching and carrying 125 pounds in a lump from a fall of 4 feet, at the rate of 3,200 per day. The solution of the problem was arrived at in the form of a 36-inch, seven-ply belt, which was installed at that time. Since its installation it is estimated that the belt has carried over 2,000,000,000 pounds of sugar before exhibiting any signs of wear. True, the belt is an enormous one and represents a large investment, but the service it has rendered is said to have exceeded all expectations. Recently, the same refinery installed a belt 1,443 feet long, 36 inches wide and weighing 11,983 pounds.

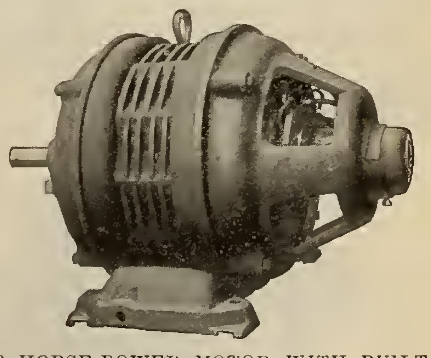
It is claimed that, estimating eight hours run without any delays, a bag of sugar will drop into the belt every nine seconds; and if the speed of the belt is such that it can make 26 to 27 revolutions every eight hours, the bags will rest at intervals of 12 feet apart. At this given speed, therefore, the belt will carry a continuous load of 60 bags or 7,500 pounds, and every nine seconds its heavily burdened surface will receive the sudden jolt and strain caused by 125 pounds dropping 4 feet.

◆

SLIP RING INDUCTION MOTOR

A NEW line of slip ring induction motors, (type CI) for severe, intermittent, varying speed service has just been developed by the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa. These motors are especially designed for heavy duty on cranes, hoists, draw bridges, roller lift bridges, railway turntables, transfer tables and similar applications. They can be furnished in sizes from 1½ to 200 horse-power for operation on two or three-phase, 220 or 440-volt, 25 and 60-cycle circuits.

The frames of the smaller sizes are made up of steel laminations riveted between forged steel end shields; in the larger sizes the frames are made of rolled open-hearth steel. The brackets are of cast iron with reinforcing ribs to assure rigidity and perfect alignment of the bearings at all times. The bearings are self-oiling of the oil-ring type, and are large in size. The steel brush holders are supported by and insulated from the bracket, which is open to permit easy inspection and renewal of the brushes.



10 HORSE-POWER MOTOR WITH BUILT-UP FRAME.

The rotor is small in diameter, thus reducing the fly wheel effect. This feature, together with perfect balance and secure attachment of the windings, makes these motors especially adapted for frequent starting, stopping, and reversing. The shaft is of axle steel and can be removed from the rotor without disturbing the windings.

The running torque of these motors is the maximum obtainable and the starting and pull-out torques in all motors exceed twice full-load torque. They are so constructed, that in case of accident, repairs can be quickly made, and maximum strength is obtained while weight and overall dimensions have been reduced to a minimum.

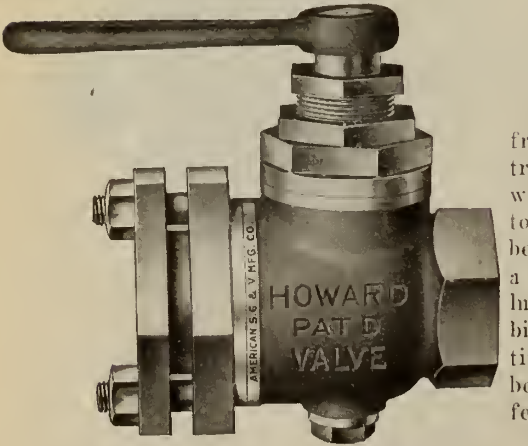
75 HORSEPOWER MOTOR WITH ROLLED STEEL FRAME.

The illustrations show a 75 horsepower motor, with rolled steel frame and a 10 horse-power motor with built-up frame construction.

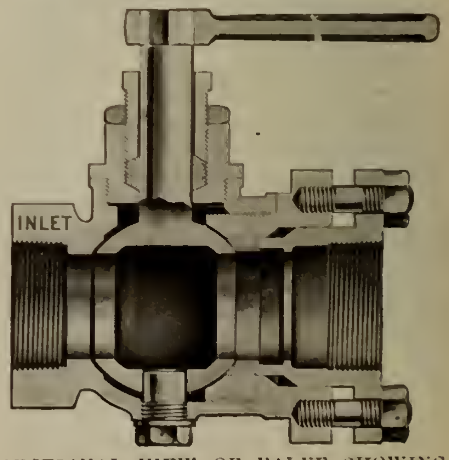
IMPROVED BALL BLOW-OFF VALVE

AN improved Howard ball blow-off valve is shown in the accompanying cuts, being now manufactured by the American Steam Gauge & Valve Mfg. Co., Boston who have recently taken over its production and sale from the Howard Iron Works.

In its improved form the valve is provided with a one-piece ball and stem which completely overcomes former trouble with inserted stems becoming detached from the ball valve. Another improvement is the addition of a guide pin at the lower side of valve which retains the valve in position against the Bakelite packing. This maintains the stem in correct alignment with the stuffing box, while the packing material now adopted possesses peculiar properties in regard to the surface of the ball, which keep the bearing surface smooth, polished, and in a state of maximum efficiency with little or no wear. A lock nut is also provided to prevent unintentional slackening of the stuffing box gland on the valve stem during use.



EXTERIOR VIEW OF BALL BLOW-OFF VALVE



SECTIONAL VIEW OF VALVE SHOWING IMPROVED CONSTRUCTION

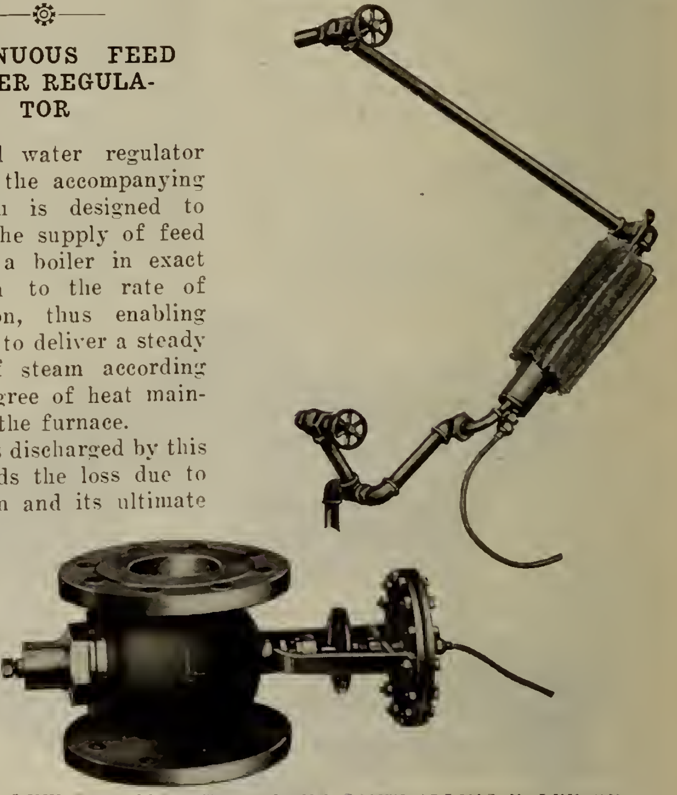
CONTINUOUS FEED WATER REGULATOR

THE feed water regulator shown in the accompanying illustration is designed to regulate the supply of feed water to a boiler in exact proportion to the rate of evaporation, thus enabling the boiler to deliver a steady supply of steam according to the degree of heat maintained in the furnace.

No exhaust steam is discharged by this regulator which avoids the loss due to the use of live steam and its ultimate loss in the ash pit.

As a result of the absence of moving parts the S-C Feed Water Regulator is not subject to wear, and the absence of any necessity for replacement insures a long life for the apparatus.

The S-C Regulator Co., Fostoria, O., state that because of its simplicity the device can be installed in about two hours.



VIEW OF REGULATOR ABOVE CONTROLLING VALVE ON FEED WATER PIPE

CENTRIFUGAL BOILER-FEED PUMPS

Because of the high head, ranging from 300 to 600 feet, the DeLaval Centrifugal Boiler Feeder is ordinarily built with from two to four stages, according to the type of drive. These pumps may be driven by direct connection either to a steam turbine or electric motor, the illustrations Figs. 1 and 2 showing a turbine driven and motor driven set respectively, the pump in the latter illustration being dismantled to show constructional features.

The pump casing is parted on the horizontal plane through the centre of the shaft, this method of construction involving only one joint which is perfectly flat and is effectually made tight by a paper gasket. As shown in Fig. 2, the interior parts of the pump, that is the shaft with the impellers mounted thereon and the wearing rings may be removed after merely lifting the casing cover and loosening the bearing caps, all of which parts can be examined and replaced without disturbing the packing.

In Fig. 3 the suction pipe is at the left, the water entering the first impeller at the hub and being reversed and directed by the casing to each succeeding impeller in turn to be finally discharged through an opening at the right, the casing at this point having the familiar volute or spiral form design.

The bearings are both ring-oiled, one being equipped with grooves to fit col-

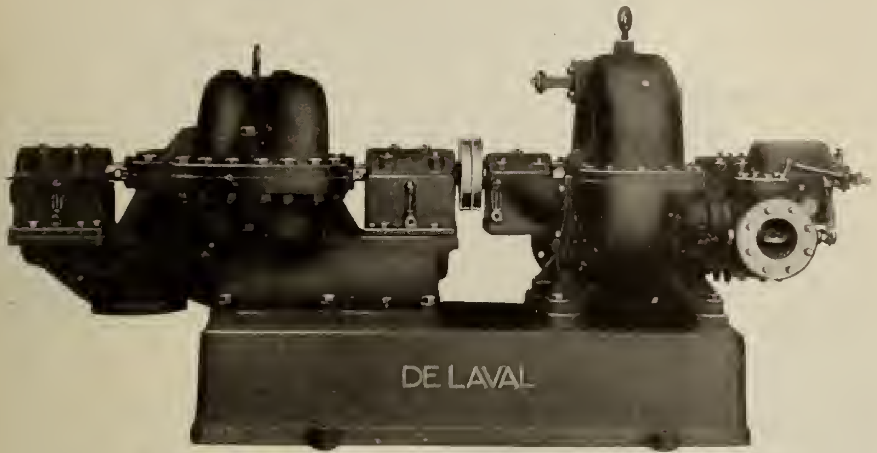


FIG. 1. STEAM TURBINE-DRIVEN CENTRIFUGAL BOILER FEED PUMP.

lars on the shaft, thus forming a marine type thrust bearing, which is provided in order to take care of possible unbalanced conditions, such as might arise under exceptional conditions. The thrust collars are formed on a removable sleeve carefully fitted to the shaft and held in place by a washer and lock nut, permitting renewal without affecting the shaft. The bearing is so fitted to the pedestal that the thrust is transmitted to the pedestal direct, without any pressure on the bearing cap.

Labyrinth wearing rings are used on these pumps to prevent leakage from the discharge chamber to the suction chamber between the impeller and the casing. Various types of rings are shown in Fig. 4, the present form of labyrinth ring adopted by this firm being shown at E. One ring (No. 583, Fig. 3) is attached to the pump casing, and the other (No. 567), attached to the revolving impeller. The intermeshing grooves form a labyrinth or tortuous passage through which the leakage water must pass, the many bends in the path of the water creating additional resistance which, with the greater absolute length of the path, greatly reduces the leakage tendency.

The shaft is covered throughout its entire length with removable bronze protecting sleeves, which, with the impellers are fastened to the shaft by two long feather keys placed on opposite sides to preserve balance. The impellers are simply slipped over these feather keys alternately with the sleeves, and the whole assembly locked by a nut at one end of the shaft.

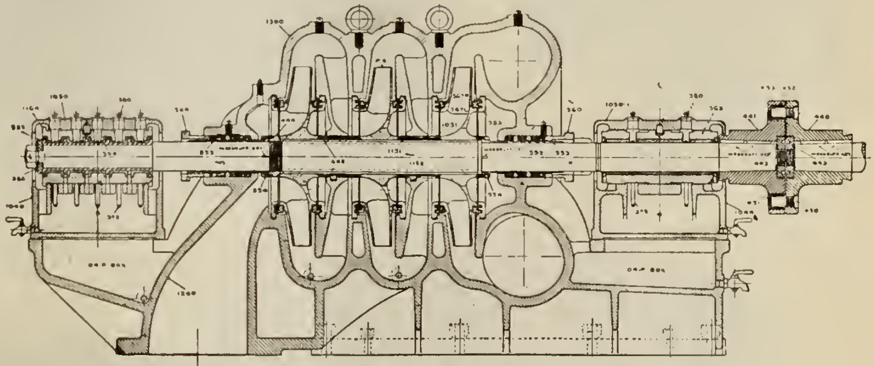


FIG. 3. TYPICAL SECTION OF "DELAVAL" MULTI-STAGE CENTRIFUGAL PUMP.

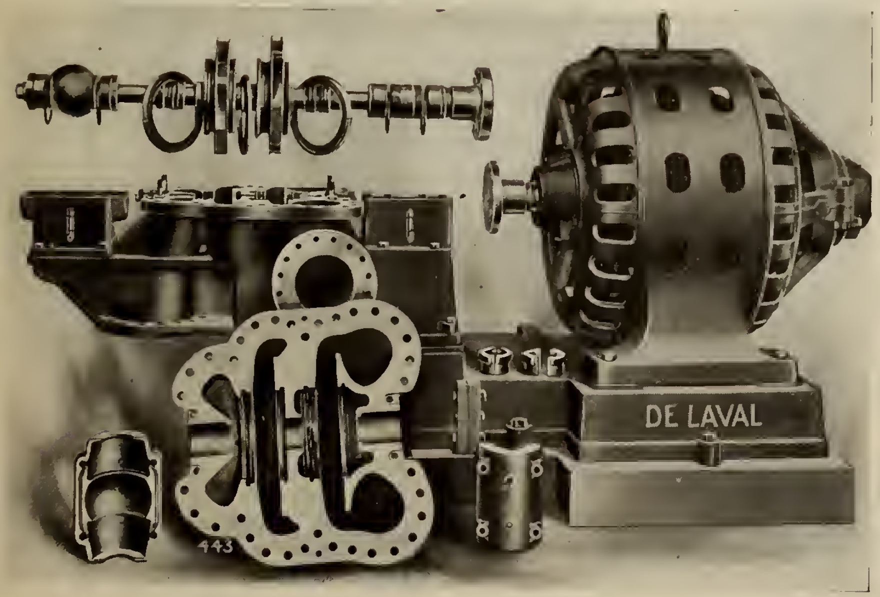


FIG. 2. DISMANTLED TWO-STAGE CENTRIFUGAL BOILER FEED PUMP WITH ELECTRIC MOTOR DRIVE.

Centrifugal boiler-feed pumps with a wide range if sizes and capacities similar to those described are built by the De Laval Steam Turbine Co., Trenton, N.J.

* * *

SIZE OF DIESEL ENGINES

THERE is a limit of size below which Diesel engines cannot be made at all, and, further, a limit below which they cannot be made commercially. A factory was at one time established at Munich to manufacture Diesel engines of 5 h. p. per cylinder on the four-stroke principle, running at 600 r.p.m. The engines were fairly successful, but the undertaking was not successful financially.

Later, in 1911, an experimental single-cylinder engine, designed to develop 10 b.h.p. at 1000 r.p.m., and working on the two-stroke Diesel cycle, was constructed and tested satisfactorily, but it was not a commercial success, since its cost exceeded by far what would be regarded as a fair market price for an engine of the power.

These cases, however, are not devoid of scientific interest, as showing that Diesel engines can be made in very small units and to operate at high speeds, although in such cases they are not marketable commodities on account of high prime cost.

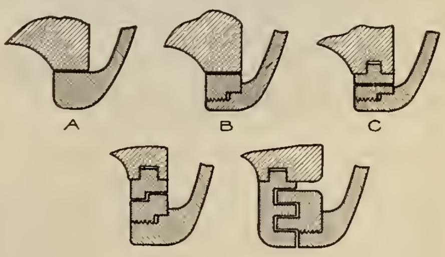


FIG. 4. SHOWING EVOLUTION OF LABYRINTH WEARING RINGS USED ON "DE LAVAL" CENTRIFUGAL PUMP. E IS THE TYPE NOW IN USE.

* * *

The application of dressing to belting while in motion leads often to serious accidents to the operator.

VALVE RE-SEATING MACHINE

WHILE the Dexter Valve Re-seating Machine is not by any means a new appliance, recent developments and improvements in its construction have given it a wider range of usefulness in various branches of engineering, repair and overhauling.

When this device was first designed, it was then only contemplated to reseat globe type valves; other types of valves had not been considered. However, the success attained in their original purpose, encouraged the makers to further develop the apparatus, until at the present time the variety of uses to which it can be adapted is almost without limit.

Fig. 1 illustrates the latest improved type of machine for re-facing valves from 3 to 6 inches. It is shown operating on a flat-seated valve. The general construction of the various sizes is more or less identical, but, in the case of this and the larger sizes, special provision is made to reduce the power required to operate the cutter.

Where the small sizes are direct driven by means of the power handle secured to cutter spindle, the larger size machines, as shown in Fig. 1, are operated by bevel gears, running in special brackets; the gear ratio and bracket construction being, of course, suited to the size of the machine.

The jaws of the universal chucking arrangement can be adapted to either internal or external use, the long sleeve in which the cutter spindle revolves, insuring the utmost rigidity, even on the heaviest work. The faces of the cutters are so constructed, that all possibility of chatter is entirely eliminated, resulting in a clean smooth finish.

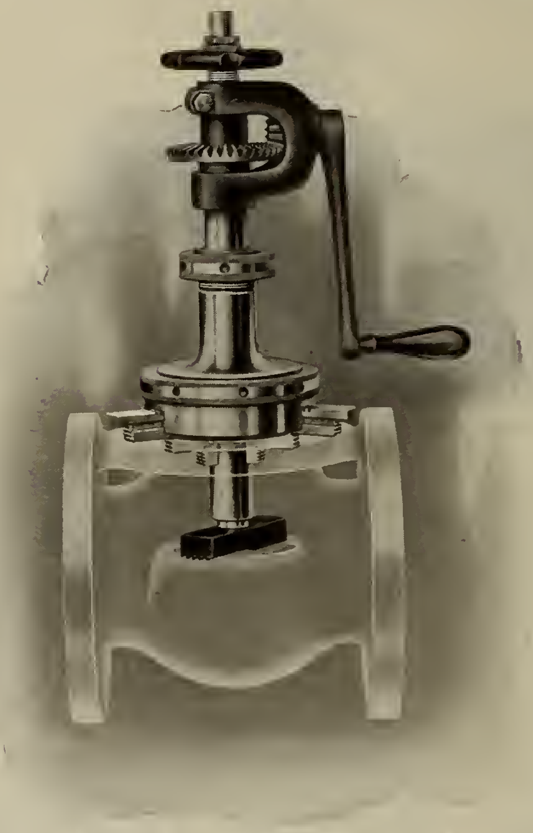


FIG. 1. MACHINE FOR RESEATING VALVES FROM 3 IN. TO 6 IN.

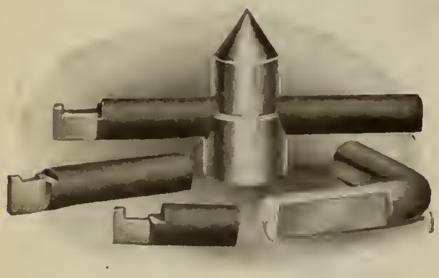


FIG. 2. CUTTERS FOR CHANNELING WORN VALVE SEATS.

After a valve has been re-faced a number of times, there arises the possibility of cutting into the uneven portion of the metal surrounding the valve seat. To overcome this, and at the same time extend the life of the valve, the attachment shown in Fig. 2, has been designed. By this simple device, a channel is cut around the old seat leaving a new ridge for further facing. By removing the sleeve and cutter spindle from the universal chuck, and securing same in a special frame as shown in Fig. 3, the valve disc can easily be re-cut.

The adjustment and operation is quite simple. With one setting of the head, a crowning face can be cut, and, by feeding forward on the knurled nut, a 45-degree angle can be cut. Again, by utilizing the feed nut of the machine, a true surface can be turned parallel with the axis of the spindle.

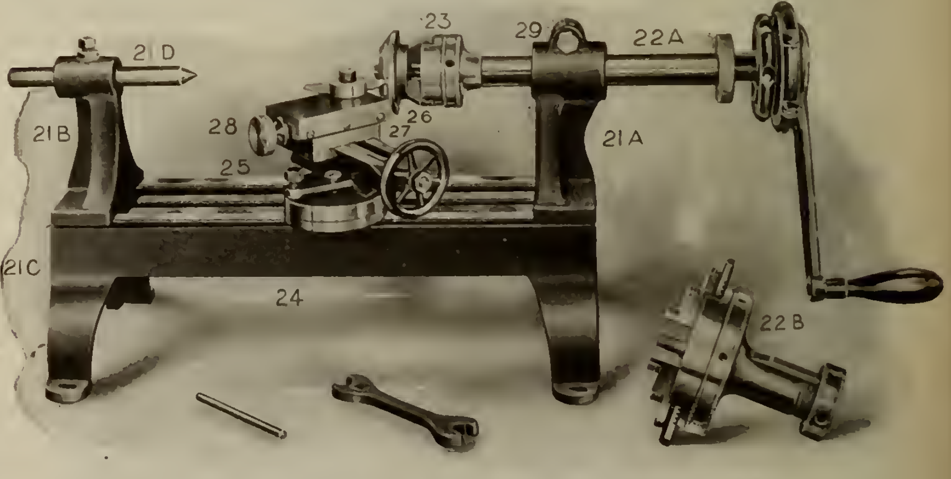


FIG. 3. RE-MACHINING DEVICE FOR WORN VALVES.

While this device was originally designed for a special purpose, it may be adapted to many jobs ordinarily performed in a small lathe. A larger size suitable for the heavier work is also constructed.

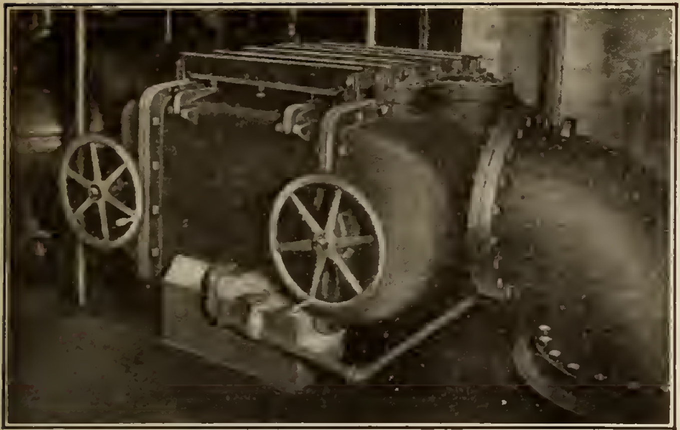
Darling Bros., Montreal, are the sole manufacturers in Canada of these valve reseating machines.

Trade Gossip

M. Beatty & Sons, Welland, Ont., have received an order for a complete coal handling outfit consisting of steel derrick, triple drum, electric hoist and clamshell bucket from the Canada Glue Co., of Brantford, Ont.; also an order from the Northern Canada Power Co. for hoisting engine, boom swinger and steel stone skips for use on the enlargement of the hydro-electric project near Timmins, Ont.

Orillia, Ont.—The rejection of the Hydro agreement involves the town in further capital expenditure of $80,000 to instal machinery in the new power house at Swift Rapids. The present plant at Ragged Rapids generates 1,700 h.p., which is inadequate to the town's requirements, and some 500 h.p. is taken from the Hydro at its big chute plant. The town's new equipment at Swift Rapids will consist of two units of 1,600 h.p. each, and provision is made for installation of additional units up to 6,000 h.p., so that by retaining and operating its generating plant Orillia will have ample power for its requirements for many years to come.

Charlottetown, P.E.I.—Tenders are being called for an oil engine-driven pump for the waterworks plant. Tenders for a boiler may be called for within a few weeks. R. S. & W. S. Lea, of Montreal, are the consulting engineers, from whom particulars may be obtained.



24" Twin Strainer in condenser circulating water line.

Twin Strainers

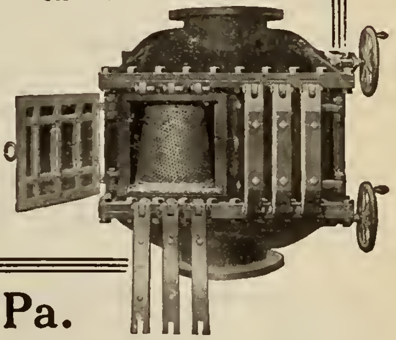
Insure Continuous Service

The Twin Strainer stands on guard twenty-four hours a day, and removes from the water all such foreign matter as dead leaves and grass, sticks, fish, etc., that would clog up and injure the pump and condenser.

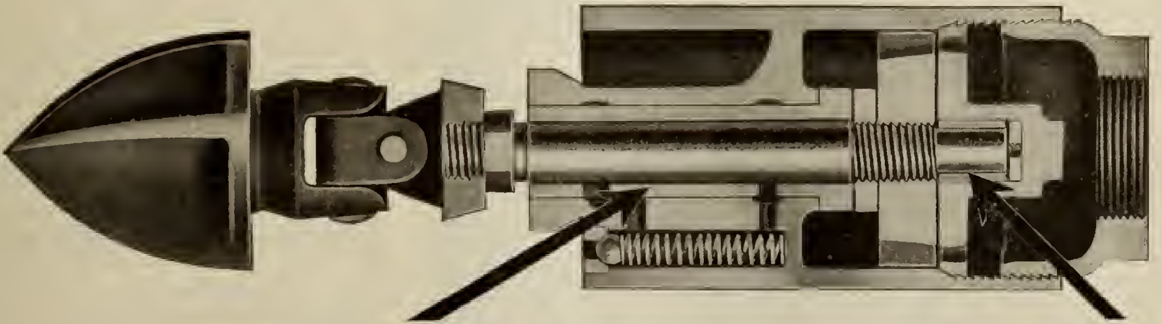
The Twin Strainer is the only direct-flow strainer that can't be clogged. When the solids accumulate in one of the two straining baskets, a clean one is put in service by simply operating two valves. The dirty basket can then be lifted out, carried to a convenient place, cleaned, and replaced in the Strainer—all this without interrupting the supply of water for an instant.

Twin users are the best boosters we have. Send for a copy of Bulletin "A" and join the army.

Twin Strainers are made in sizes ranging from 1 to 48 ins. with perforations in the straining baskets to suit your service.



Elliott Company, 6902 Susquehanna St., Pittsburgh, Pa.



BUSHED BEARINGS ARE BEST

IN A TUBE CLEANER

Because the weight of the rotating parts is so small that the friction load on any type of bearing in good condition is negligible compared with the load of removing scale.

BUT—there is a shock load due to vibration. And you know that ball and roller bearings will not stand up under shock. And it is impossible to keep the grit and dust from the scale out of ball or roller bearings.

The LIBERTY CLEANER uses bushed bearings which do stand up under shock and which are practically impervious to grit. On account of wear, the friction load on ball or roller bearing Tube Cleaners increases rapidly with use. Friction load on LIBERTY bearings does not increase.

GET THE BEST—GET THE LIBERTY.

LIBERTY MANUFACTURING COMPANY **6904 Susquehanna Street**
Pittsburgh, Pa.

Canadian Representatives: Williams & Wilson, Ltd., Montreal; A. R. Williams Machinery Co., Toronto and Winnipeg

Watrous, Sask.—The Watrous Electric Light Co. will install a new gas producer plant.

Gananoque, Ont.—The Town Council contemplate making extensions to the waterworks system.

Charles L. Marble has been appointed manager of the Wayne Oil Tank & Pump Co., of Woodstock, Ont.

Stratford, Ont.—The local Hydro-Electric Commission contemplate installing three 750 k.w. transformers.

Edmonton, Alta.—The Alliance Power Co. has been incorporated to build and operate power plants, etc., $250,000 capital stock.

Stratford, Ont. — The local Hydro-Electric Commission has decided to install three transformers at a cost of $35,000.

Mussens, Ltd., Montreal, have been awarded a contract for two gasoline-driven diaphragm pumps by the Board of Control, Toronto.

A. F. Macallum, for seven years city engineer of Hamilton, Ont., has been appointed Commissioner of Works of the city of Ottawa, Ont.

St. John, N.B. — The City Council contemplate making considerable improvements and extensions to the water distribution system.

St. John, N.B.—The city council are considering the installation of a incinerator. The work will probably be proceeded with this year.

Estevan, Sask.—A by-law will be voted on by the ratepayers to raise $5,000 to pay for the completion of the electric power plant.

Vancouver, B.C.—The City Council will install a 4-in. pump, including motor, at the Parker Street pumping station. F. L. Fellows is the engineer.

J. E. B. Phelps, former chief engineer of the Sarnia Electric Light Co., has been appointed general manager of the Sarnia Hydro-Electric Commission.

Point aux Trembles, Que.—The town council have under consideration a number of civic improvements, including the installation of a waterworks system.

The Smart-Turner Co., Hamilton, Ont., have been awarded a contract for a high power duplex pump by the city of Toronto for the high level pumping station.

The Ferranti Co., have been awarded a contract by the City of Winnipeg for three transformers for the King St. substation of the light and power department at $9,650.

Killarney, Man.—The Crescent Creamery Co., propose establishing a creamery here to cost $5,000. The town gives the company exemption from taxation on their plant for a period of five years.

The Three Rivers Cold Storage & Ice Co. has been incorporated at Ottawa with a capital of $50,000 to carry on a cold storage and ice business at Three Rivers, Que. Incorporators: S. Malone, A. J. Gouin and F. H. Mahone, all of Three Rivers, Que.

The Dominion Tygard Engine Mfg. Co., has been incorporated at Toronto, Ont., with a capital of $100,000 to manufacture steam or gas engines and accessories therefore. Head office at Toronto. Incorporators are Adam M. Cook and Irene House of Toronto.

The Sarnia Creamery Co. has been incorporated at Toronto with a capital of $100,000 to manufacture ice cream and ice, and also pasteurize milk. Head office is at Sarnia, Ont., and the incorporators are: R. Sharpe, T. H. Lucas and J. W. Lawrence, all of Sarnia, Ont.

The Sanitary Heating and Ventilating Co. has been incorporated at Ottawa with a capital of $50,000 to manufacture electrical and heating appliances of all kinds. Head office to be situated at Ottawa. Incorporators: A. E. Adams, O. G. J. O'Regan, and J. H. Barker, all of Ottawa.

The McArthur Belting Co. has been incorporated at Ottawa with a capital of $40,000 to acquire the business of D. J. McArthur & Co. , manufacturers of leather beltings. Head office to be situated at Brockville, Ont. Incorporators: J. D. McArthur and J. S. McArthur, of Brockville, Ont.

Edmonton, Alta. — The Provincial Legislature has ratified an agreement between the Edmonton Power Co., care G. W. Farrell & Co., Montreal, Que., and the Edmonton City Council, for the supply of power for 21 years. The company will construct a power house, large dam, electric railway and other works at a cost of $6,000,000.

The Pas, Man.—Tenders, addressed to H. H. Elliott, M.D., secretary-treasurer of the Town of The Pas., Man., will be received up to June 22, 1916, for the supply and delivery of the following machinery and materials:—Tender "A"—For the supply and delivery of two sewage lift pumps. Tender "B"—For the construction of a sewage lift chamber. Plans and specifications may be seen at the office of Murphy & Underwood, consulting engineers, Saskatoon, Sask., and the resident engineer, The Pas, Man.

Major Norman C. Pilcher, formerly general manager of the Sherbrooke Railway & Power Co., has been killed in action in Flanders while serving with the Canadian Mounted Rifles. Major Pilcher was born in England 36 years ago, but had lived in Canada for 24 years. He went to South Africa with the Canadian contingent during the Boer War. On returning to Canada, he was for a time manager of the Fort William Tramways, coming from that city to take the post in Sherbrooke, which he held until leaving for the front.

Government Stands by Hydro Scheme.—The material setting forth the position of the Province of Ontario in regard to the diversion of water at Chippewa Creek for the proposed new hydro development has been sent by Hon. I. B. Lucas to Ottawa, where it will form the basis of the Dominion Government's reply to the objections raised by the United States Government recently. The Ontario Government has taken the stand that it is within its rights in diverting water from Chippewa Creek, but a detailed statement of the Government's answer will be left to the Federal authorities, in whose hands such international matters properly rest.

Plant Extension.—The Goldie & McCulloch Co., Galt, Ont., are making an addition to their South Works plant in the shape of a new power house. This will be thoroughly modern in every respect. It will be equipped with coal and ash handling apparatus, the coal being delivered to the bunkers direct from hopper-bottomed cars. The boilers will be Goldie & McCulloch sectional water tube type, with superheaters and automatic stokers, and the engines will be Goldie & McCulloch vertical type, direct connected to d.c. generators. Besides the engines and generators, the engine room will contain the switchboard, a vertical air compressor and the usual condenser and feed pumps. These latter as well as the feed water heaters will be of Goldie & McCulloch make. A complete new hot water forced circulation heating system is to be installed for heating the present shop buildings. The pump for circulating the heating water will be of the centrifugal type driven by a Goldie & McCulloch steam turbine.

Catalogues

The York Mfg. Co., York, Pa., have issued a bulletin dealing with their vertical shell and tube steam condenser for ice plants. Copies of the bulletin may be obtained from the Canadian Ice Machine Co., Toronto.

Electric Instruments. — Bulletin No. 100 describes a line of electrical instruments made by the Roller-Smith Co., New York, for signal system testing. Full particulars are given covering each

Chosen for all Important Jobs

All large, important installations of economizers made recently for central power stations have been Sturtevant machines. In each case the economizers were carefully investigated by prominent consulting power plant engineers and Sturtevant machines were ultimately specified.

If prominent, experienced consulting engineers cast their vote in favor of Sturtevant economizers, they should be good enough for you.

Write full information giving details of your conditions.

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Fuel Economizer

B. F. Sturtevant Company of Canada, Limited
GALT, ONTARIO, CANADA
MONTREAL TORONTO WINNIPEG VANCOUVER
Selling Agents: Sanford Riley Stoker Co., Ltd., "THE RILEY STOKER"

Spray Cooling Increases Capacity of Natural Ponds 36 Times

Even if you have no natural supply of cool water, such as a river or pond, you can maintain a 28" vacuum in your condenser and do it at low cost with a

SPRACO COOLING POND

The Spray System of cooling requires a relatively small amount of water. The first cost of the system is less than for a cooling tower, the operating cost is about one-half as much, and there is practically no depreciation.

Hundreds of installations in high-grade power plants are proving the economy and reliability of Spray Systems. We design and equip your entire system and guarantee results.

Send for complete information.

SPRAY ENGINEERING CO., 93 Federal St., Boston, Mass.

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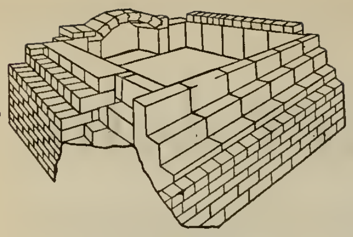


Gates Boiler Furnace

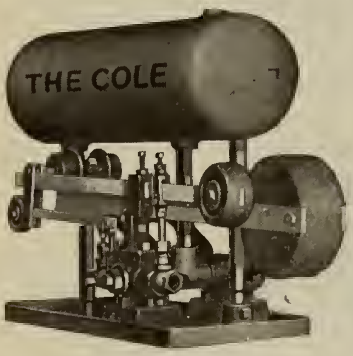
Patent Applied For

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

—WRITE FOR PARTICULARS.—

John W. Gates

62 St. James St
Montreal, Que.



The Word Condensation

is composed of twelve letters. We also know it is composed of many *DOLLARS,* so why should we waste them when there is a way to save them.

The "Cole" Back to the Boiler System

WILL SHOW YOU. It would pay you to investigate. Let us know your troubles, and we will tell you how to remedy them.

BOOKLET ON REQUEST

Geo. W. Cole Co.

838 Dundas St., Toronto, Ont.

type of instrument and a series of diagrams of facsimile scales are also included.

The York Mfg. Co., York, Pa., have issued a bulletin dealing with the "York" enclosed refrigerating machine which is well adapted for markets, dairies, ice cream factories, etc. The bulletin is illustrated and the important features of the machine are briefly described.

The Bayer Steam Soot Blower for Torizontal Fire-Tube Boilers, is the title of a new 16-page bulletin just published by the Bayer Steam Soot Blower Co., St. Louis. The bulletin shows details of construction and operation and contains the experience of users and manufacturers. A free copy will be sent to engineers on request.

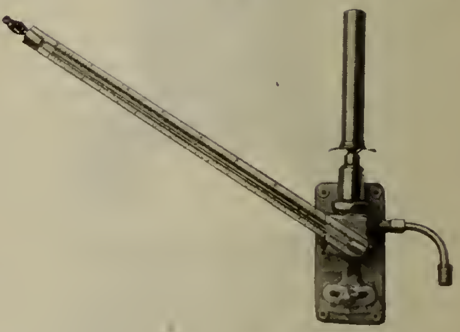
The Penberthy Injector Co., Windsor, Ont., have issued an engineer's ready reference book for the boiler and engine room. The book contains 21 pages and deals with the "Penberthy" line of injectors, lubricators, "Compodisk" valves, oilers, etc. Each type of apparatus is illustrated and described together with a price list and particulars of each size.

Fittings.—The Detroit Valve & Fittings Co., Detroit, Mich., have issued catalogue No. 3 to the trade. The piece list on straight size fittings has been revised and a piece list added on all reducing sizes. These lists are based on the estimated average weights of the fittings and so figured that piece fittings take a uniform discount. This list includes malleable iron fittings for steam, gas and water, drainage fittings and specialties also malleable and grey iron castings. The piece lists are very complete and the catalogues fully illustrated.

The Prevention of Scale Formation is the title of a bulletin issued by the Buckeye Skimmer Co., Toledo, Ohio. The basis of the bulletin is a short talk on scale, and its removal from steam boilers by using the "Buckeye" boiler skimmer. The formation of scale in boilers and its removal is dealt with in a general way followed by a description of the "Buckeye" skimmer and its method of operation. The claims made for this apparatus are dealt with at length accompanied by illustrations showing it installed in various types of boilers.

Manganese Chains.—The Jeffrey Mfg. Co., Columbus, Ohio, are now ready to distribute to the trade their latest Bulletin No. 171 dealing with manganese chains. This bulletin contains full details and prices of detachable, "Peerless" and "Hercules" types of manganese chains, sprockets, and attachments,

Universal
LIQUID
MEASURING
Devices



THE above cut is simply one of many types of measuring instruments, and we will be glad to supply instruments covering any class of liquid measuring on receipt of the following data:

1. Sp.G. of Liquid to be measured.
2. Depth of container.
3. Approximate location of container from Instrument.
4. Scale per foot of depth required on the instrument.
5. Maximum and minimum depths of liquid to be measured.
6. Whether the tank is exposed to frost.
7. Whether tank is vented.

On receiving information we will advise on best type of instrument.

This instrument measures the quantity of water or other liquid in a tank, well, stream or in almost any situation, and is absolutely free from mechanical devices, except for a small air pump at the instrument itself.

ALWAYS READY, ALWAYS SURE — ALWAYS KEEPS YOU POSTED ON THE QUANTITY OF LIQUID ON HAND, SAVES MUCH TIME AND PREVENTS "RUNNING SHORT."

Can be placed close to or far away from the liquid. It does not matter where the liquid to be measured is in relation to the device, as all you have to do is to run a piece of ¼ in. pipe from the tank to the instrument and the tank may be below or above ground, or hundreds of feet from the instrument, which latter is placed at any convenient position in the office or desired room.

Drop a line for circular and full particulars.

UNIVERSAL MEASURING
DEVICES, Limited

125 ISABELLA STREET, TORONTO

Classified Advertisements

FOR SALE

FOR SALE—TWO HORIZONTAL RETURN tubular boilers 60" x 16', built to comply with Ontario Government specifications. Made in St. Catharines for a special order. Full particulars and details upon application to Taylor-Forbes Co., Ltd., Guelph, or Taylor-Forbes Co., 1088 King Street West, Toronto.

FOR SALE — TWO GOLDIE-McCULLOCH Wheelock Engines—cylinders 16" diameter, 38" stroke; both engines now running, but will be replaced with Hydro-Electric. Engines guaranteed to be in perfect condition, and will be sold complete with belt wheels, one 14' x 35" face and one 12' diameter with 24" face, also belting if required. Canadian Consolidated Felt Co., Berlin, Canada. (7)

USED POWER EQUIPMENT.

ENGINES.

75 H.P., 16 x 36 Leonard Corliss, used less than year; heavy duty type.
85 H.P., 13 x 30 Brown automatic, excellent condition.
75 H.P., 12 x 30 Inglis Corliss
75 H.P., 12 x 12 Robb high-speed.
20 H.P. Robb high-speed.

BOILERS.

72 x 18 horizontal return tubular, shaking grates, Government inspected.

GENERATORS AND MOTORS.

200—300-light dynamos.
20, 25, 35, 250-volt motors.
50 H.P. gas engine and producer, good as new, at great bargain.
Hobbs & McGill, Mail Building, Toronto, Ont.

Give your belts a square deal by using Dixon's

Don't let them go hungry and starve. They can't give you service unless they are properly treated.

The use of Dixon's Belt Dressing means added power to your plant, longer life to your belts.

Send for booklet 222-O

Canadian Representatives:
Canadian Asbestos Co., Montreal, Quebec

Made in JERSEY CITY, N.J., by the

JOSEPH DIXON CRUCIBLE COMPANY

Established 1827

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which insure a maximum of elevator and conveyer service in aggravating cases of wear, where the conditions require that the chains and sprockets not only handle gritty and abrasive materials, but come in actual contact with them. All styles and sizes of chains shown in this Bulletin are carried in stock for immediate delivery, while others will be added as fast as facilities permit. Copies may be obtained from the company's office, Power Bldg., Craig street, Montreal.

Oil Filters.—Bulletin No. 5, recently issued by the Richardson-Phenix Co., Milwaukee, Wis., describes a complete line of filters for purifying lubricating oil, having capacities of from 25 gallons per day to 50,000 gallons per hour. This is a most complete oil filter catalogue and describes some exceedingly interesting large size filters for use in purifying lubricating oil from water wheel thrust bearings, large gas and steam engines in steel mills, and also for purifying cutting lubricants. The catalogue serves to indicate the remarkable advance made in recent years in the science of oil filtration, and shows how scientific principles are employed in the small as well as the large size filters. The catalogue is profusely illustrated and contains prices on the various size filters. Copies may be had by addressing the company as above.

MacKinnon, Holmes & Company, LTD
SHERBROOKE, QUE.

We build-
COAL BUNKERS
OIL TANKS
WATER TANKS
AIR RECEIVERS
and miscellaneous plate and structural work of every description used in connection with power plants.

GENUINE
ARMSTRONG STOCKS AND DIES
MALLEABLE IRON HINGED PIPE VISES, PIPE CUTTERS, PIPE MACHINES.
MANUFACTURED BY
THE ARMSTRONG MFG. CO.
298 KNOWLTON STREET
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Patents
Trade Marks and Designs in all countries
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Designer and builder of power and manufacturing plants, abattoirs, cold storage and packing house equipments. Factories constructed on the economy fire-proof plan. Ice-making plants and refrigeration installed.

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INFALLIBLE

Works Equally Well on Hot and Cold Surfaces. It Cannot Blow Up. Cleans, Polishes and Preserves all kinds of metals.

Tear this off as a reminder

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557 E. Wash. St.
Indianapolis, Ind.

Enclosed find 10c in stamps, for which send me one large 50c can of U. S. Metal Polish Paste.

Name ....
Address ....
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MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE

To Manufacturers, Dealers and Users of Steam Boilers

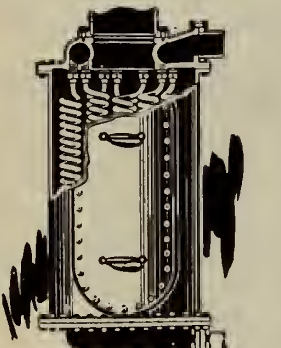
All steam boilers built in, or entering the Province of Ontario, and boilers exchanged or repaired are subject to Government Inspection as prescribed in the Steam Boilers Act, 3 George V., C. 61.

Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department, stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the Regulations by an Inspector authorized under the Act.

All communications should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G. MACDIARMID, Minister of Public Works.

D. M. MEDCALF, Chief Inspector of Steam Boilers.



Reilly Multicoil Feed Water Heater

Has greater capacity per square foot of heating surface than any other type of closed heater. It is simple in construction, light in weight and small in size.

Write for Bulletin No. 210.

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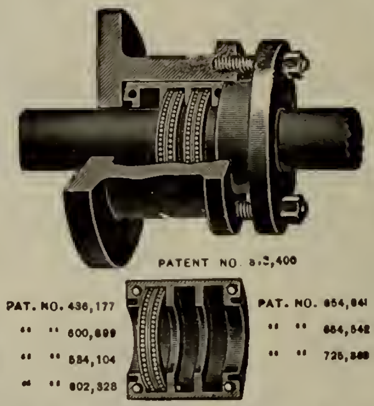

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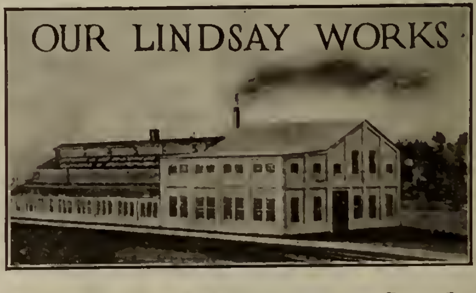

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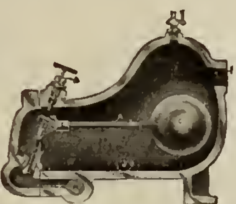

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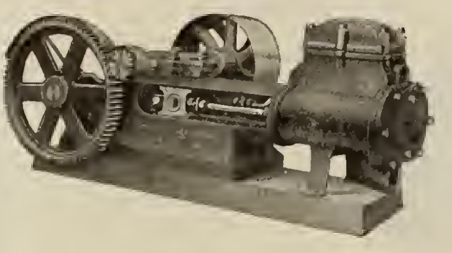

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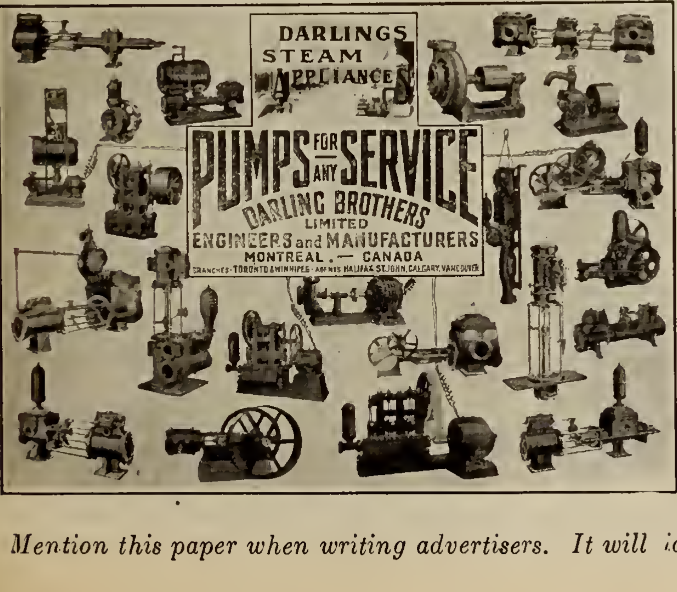

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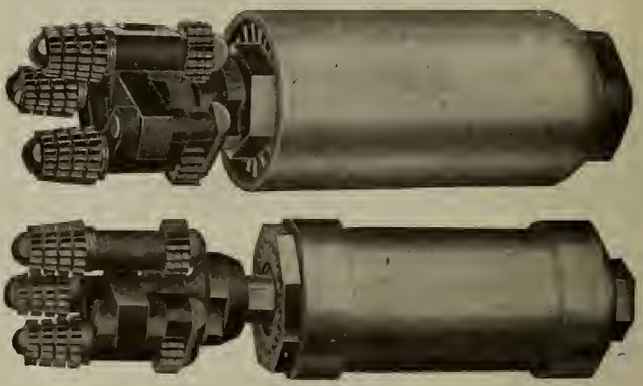

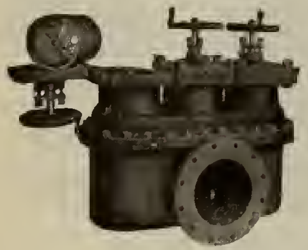

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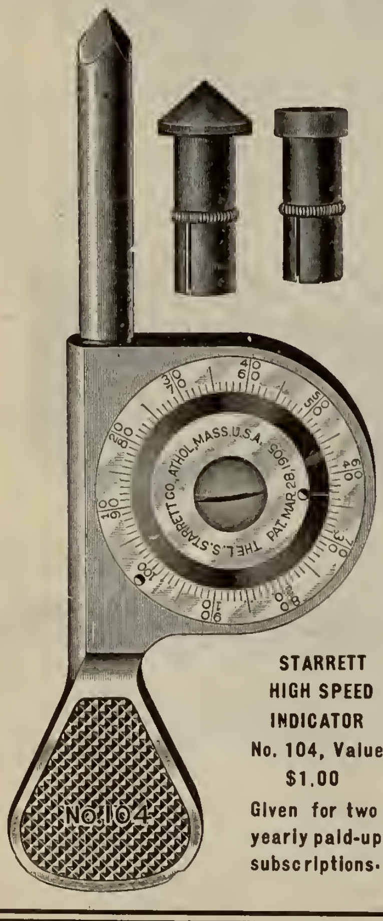
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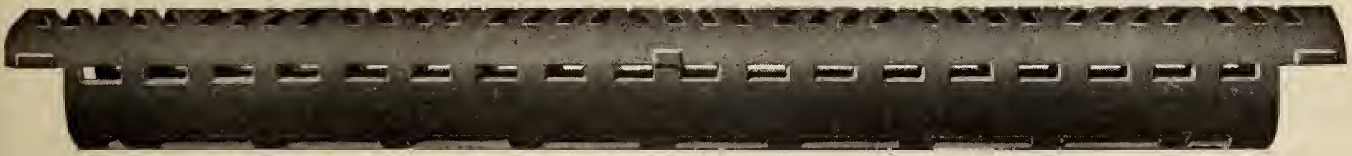

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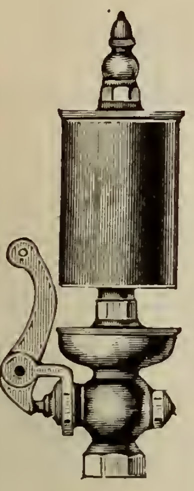

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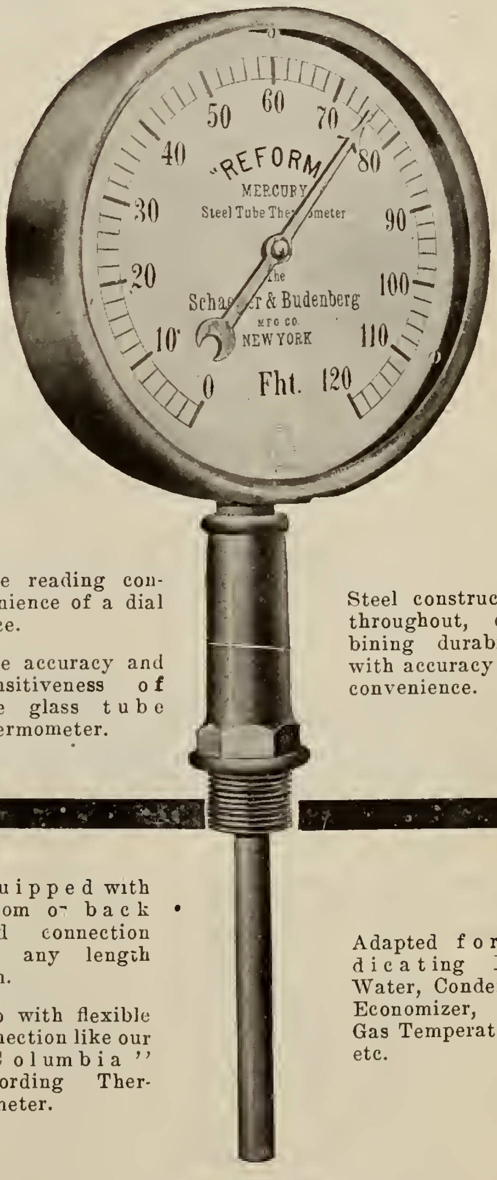

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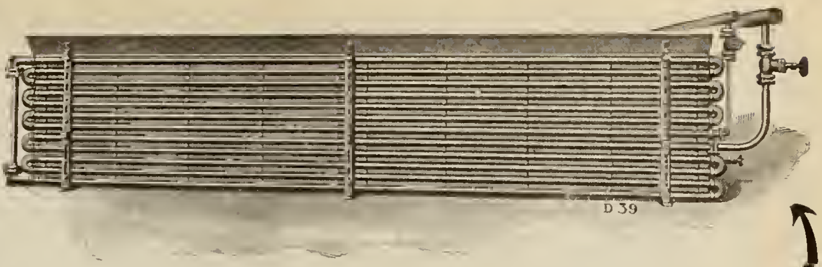

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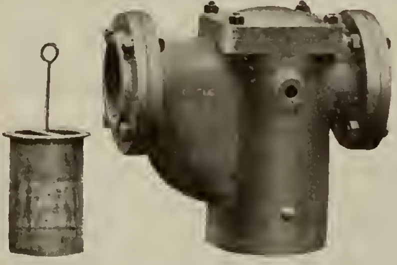

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Vol. IX. TORONTO, JUNE, 1916 No. 6

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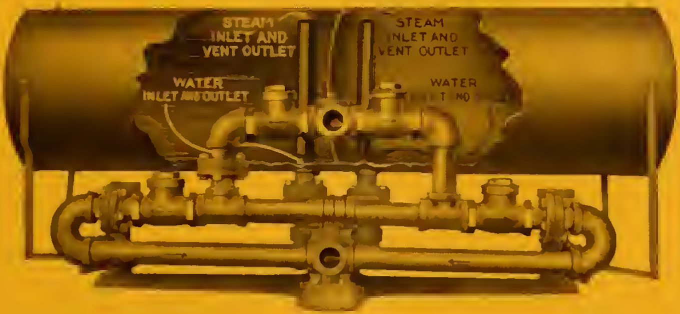

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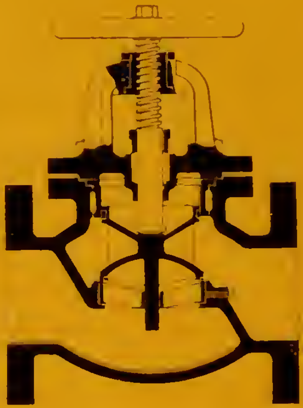

Beaver Non-Return Stop and Equalizing Valves

The great importance of Non-return Stop Valves for use on a battery of boilers is universally acknowledged, and in some provinces their installation is compulsory. It is evident that should a tube be blown out or a fitting ruptured in one of the boilers of a battery, the steam from the other boilers would rush into the header and discharge into the disabled one. An ordinary stop valve would be inadequate in such an emergency, as considerable time would be lost in reaching and closing the valve.

A Beaver Non-return Stop Valve will prevent steam from being turned into a boiler which has been cut out for cleaning or repairs, as it cannot be opened by hand when pressure is on the header side. It can, however, be closed when desired.

Beaver Check Valves

have double guided valves, and are so designed that the back pressure comes on top of the valve. This prevents side wear and insures the valve closing promptly.

Beaver Check Valves embody all the features found in Beaver Globe and Angle Valves.

The James Morrison Brass Mfg. Co., Limited

93-97 Adelaide Street West
TORONTO, ONT.

Beaver Cross Valves

are constructed on the same lines as Beaver Angle Valves, embodying all the angle valve features, and can be furnished in stop or adjustable check pattern.

C.A.S.E. PRE-CONVENTION NUMBER

EDITORIAL INDEX PAGE—101 ADVERTISING INDEX PAGE—102

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.

Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-153 University Ave. WINNIPEG: 34 Royal Bank Bldg
LONDON, ENG.: 88 Fleet St., E.C.

Vol. IX Publication Office, Toronto—July, 1916 No. 7

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TRADE PENBERTHY MARK

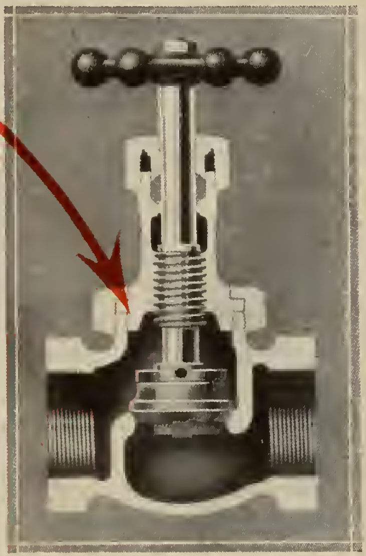
ALL QUALITY BRASS VALVES

COMPODISK
with the Composition Disc

REGRINDING
with the Metal Disc

ALL PENBERTHY VALVES HAVE THE EXTERNAL THREAD CONSTRUCTION

STRONG
Where others are weak.



APPROVED FOR 175 LBS. PRESSURE

APPROVED FOR 200 LBS. PRESSURE

Outside Thread Construction

Why These Valves Are Superior

1. The connection is non-corrosive because the threads (see cut) are on the outside, away from the action of steam and water, making it impossible for them to become lined up and corroded.
2. The connection is stronger, more rigid and always steam-tight.
3. Prevents straining or spreading of bonnet end of valve which causes a loose fitting and unsafe bonnet—Safety First.
4. It prevents stripping of threads.
5. It permits easy accessibility to the valve at any time without injury to any part of it.
6. It is the only correct mechanical method of fastening bonnet to body of valve.
7. The external thread construction permits of a more compact shaped valve, consequently a stronger one.

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Manufactured by
PENBERTHY INJECTOR CO., LIMITED, WINDSOR ONTARIO

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but all Peerless Products mean Security

At the C.A.S.E. Convention—Montreal, week of July 24th,—our Canadian Representatives, **Canadian Asbestos Co.**, will show and tell you all about PEERLESS PRODUCTS.

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WE CAN BUILD
IT—RIGHT

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Whatever is best in material, whatever is best in manufacturing methods — that is the spirit which symbolizes Jenckes Boiler Construction.

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We have on hand a well-assorted stock of Boilers, both finished and in course of construction.
All sizes to any Provincial Act.

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Your acquaintance with

"Hoyt" Frost King

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is sure to make you want more

Our customers everywhere comment on its wonderful ability to withstand heavy duty.

"Hoyt Frost King" gives extraordinary results for all classes of stationary engines, pumps, rolling mills, pulp machinery and planing mills.

The result of forty years' experience in metal mixing.

Order from your dealer; if he cannot supply you, we will be pleased to make you a shipment of a twenty-five pound box.

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For babbitting dynamos and motors we strongly recommend our "Nickel Genuine."

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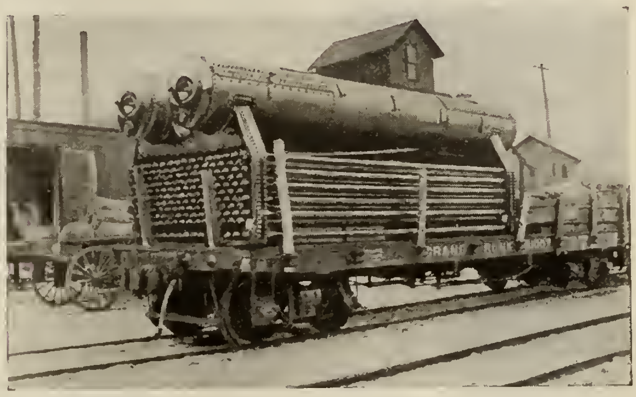
We Build:

WATER TUBE BOILERS like this



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Send us your specifications and blue prints.

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CORROSION OF BOILER
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SUNDAY WORK
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TUBES—
BLISTERS—
REPAIRS—
WORRY—
FUEL WASTE—

You Won't See a Thing You Like On That List!

On the other hand you'll see a lot of things you don't like—a lot of things you'd like to avoid in the future. Some of them you've come to look upon as unavoidable but there isn't a single one that can't be eliminated from your plant and from your boilers if you go about it right.

"Going about it right" means using

Dearborn Treatment

For by the Dearborn method most internal boiler troubles can be successfully overcome—certainly all the troubles we have listed here.

Send us gallon sample of your feed supply for analysis and let us advise definitely regarding your special needs.

Dearborn Chemical Company of Canada
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General Offices, Laboratories and Works:
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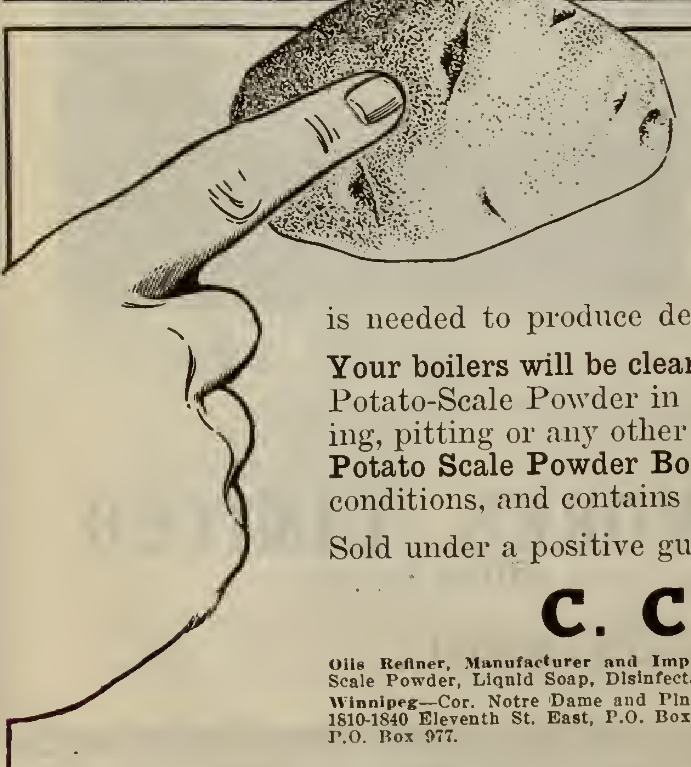
Potato Scale Powder Boiler Cleanser



Makes and Keeps Boilers New in Efficiency and Economy

You cannot afford to let scale accumulate in your boilers because it reduces their efficiency, which means a larger amount of fuel is needed to produce desired steam pressure.

Your boilers will be clean all the time if you use a small quantity of Potato-Scale Powder in your feed water daily—there will be no foaming, pitting or any other troubles due to impurities in the feed water. **Potato Scale Powder Boiler Cleanser** is made to suit your feed water conditions, and contains nothing injurious to tubes or fittings.

Sold under a positive guarantee. **Try a barrel.**

C. C. SNOWDON

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Dean
REG. U.S. PAT. OFF.

Studios & Laboratory of The Vitagraph Company of America
BROOKLYN, NEW YORK

Dean
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A Star Part in the Movies

Charlie Chaplin jumps to the dizzy heights of a $100,000 salary and his fame as a movie star circles the globe.

Why? Because he possesses the peculiar capacity for doing one thing supremely well—and thereby earns the money.

The Vitagraph Company of America pays people for what they *know how to do* exceptionally well. It also buys what it needs in the way of equipment on the same basis.

Therefore, it is not extraordinary that there is now a Dean Boiler Tube Cleaner in the boiler room of the Vitagraph Company in Brooklyn, N.Y. It was bought because, better than any other mechanical cleaner, better than compounds, better than graphite and other metal treatments, the Dean easily demonstrated to this great amusement-producing company its ability to remove scale from boiler tubes—*supremely well.*

The next time you attend the movies and see a Vitagraph Blue Ribbon Feature, remember this:

The Dean Cleaner played a "star" part in that picture, because it helped to keep the boilers clean, the steam up and the coal bills down; because its use gave the plant more power—and more power helped to speed up production, making it more efficient—while efficient production meant a better Vitagraph picture.

C. A. S. E.

Visitors to the Convention are cordially invited to visit the office of our Montreal representatives: **Francis Hankin & Co., Ltd., 201-202 Coristine Building**, who will be glad to explain the Dean Cleaner in detail.

FREE—Admission—FREE

This is a free performance. You may try the Dean Cleaner in one of your own boilers at our expense (excepting transportation one way). If it doesn't make good for you, as it has for the Vitagraph Company and thousands of others, we'll pay the freight back.

Give the Dean a chance to show you how scale can be removed from your boilers **supremely well.**

The William B. Pierce Company

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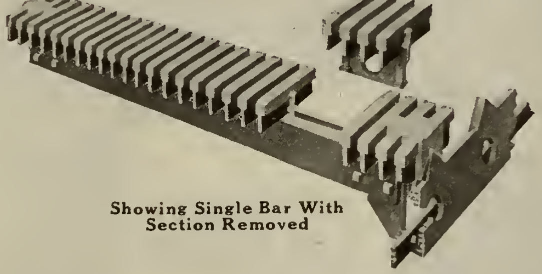
High Efficiency

Low Repairs



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The McNaughton Rocking Sectional Grate Bar

Specially designed to burn all grades of fuel and lignite.

Used in over 1000 Power Plants Developing nearly 200,000 H.P.

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W. J. Crothers Co., Limited, Kingston, Ont.	3	"
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National Fireproofing Co., Ltd., Toronto, Ont.	3	"
Canadian Explosives Limited (1300 H.P.), Montreal, P.Q.	5	"
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MANUFACTURERS
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MADE IN CANADA

Boiler Metal Treatment

This is the declaration of over 25,000 progressive Engineers—the verdict of the user.

Don't confuse Perolin with Boiler compounds.

While it's fed to the boiler in the same way as compounds it is positively independent of water conditions. It does not treat the feed water—it treats the metal and boiler metals are universally the same.

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Non-return Safety Boiler Stop Valve

"An absolute necessity on boilers connected in battery"

The most extensive line of High-grade Engineering Specialties made.

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Write for Registration Numbers Booklet.

Its function is to automatically close and instantaneously cut out a boiler connected in battery, when the pressure within the boiler suddenly drops below that in the header—a condition that may be caused by the blowing out of a tube, rupture of the shell, etc.

It reduces the danger of injury to boiler room operatives, permitting them to safely pursue their duties while operating the other boilers, and facilitates the safe and continued operation of the other boilers without loss of time.

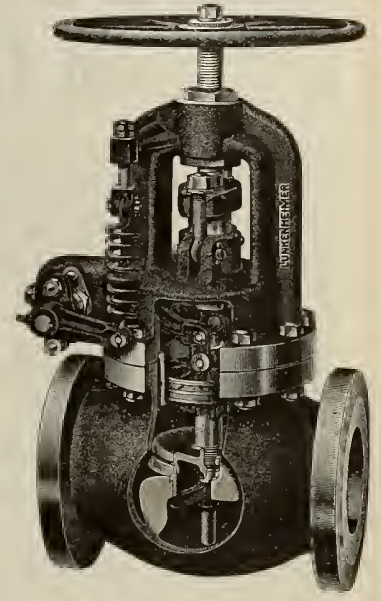
It safeguards the lives of workmen who may have occasion to enter a dead boiler, should the regular stop valve fail or be opened through carelessness, as this valve cannot be opened by hand. It can, however, be closed at any time.

When placing a boiler in service, this valve will not open until the boiler generates steam to a pressure equal to that of the others of the battery.

The spring balance mechanism, dash-pot and disc-extension eliminate chattering and relieve the shock incident to closing.

Globe and Angle Patterns, sizes 3 to 10 inches, inclusive, for working steam pressures up to 350 pounds.

Your local dealer can furnish them; if not, write us. Write for booklet No. 525.



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"QUALITY"
Largest Manufacturers of
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We extend you a cordial invitation to visit our exhibit at the Canadian Association of Stationary Engineers Convention, at Montreal, July 26th-29th.

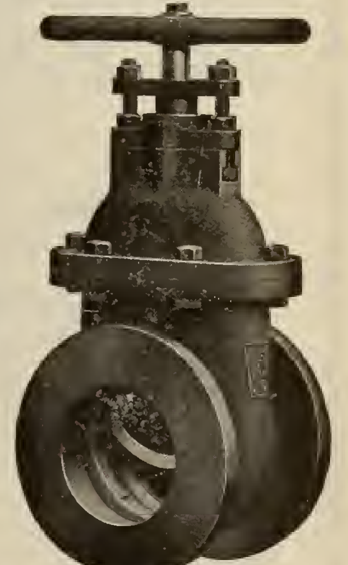
10-9-13

KERR

("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.



When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

If any advertisement interests you, tear it out now and place with letters to be answered.

JENKINS BROS.' VALVES

Have a Host of Imitators

It pays to insist upon getting the genuine. Because it is only with genuine Jenkins Bros.' Valves that you are sure of the service which has given these valves their reputation. The *appearance* of Jenkins Bros.' Valves can be copied, but the *service* goes only with the original.

We make a valve for every service.

Look for the Diamond trade mark before buying.

TRADE JENKINS MARK
Jenkins Bros 2

Made in Canada

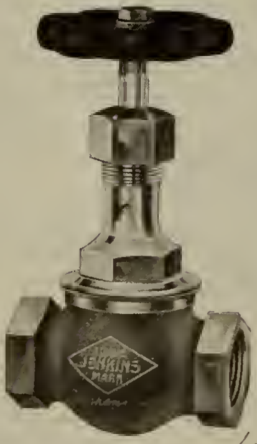


Fig. 106 4

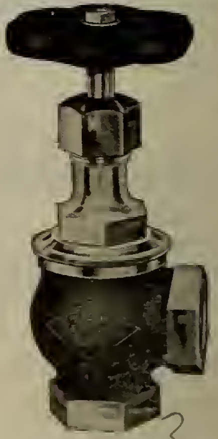


Fig. 108 3

JENKINS BROS.' VALVES are approved for use in Ontario and the Western Provinces by the Departments of Public Works.

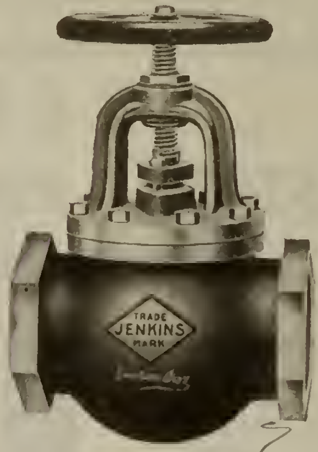


Fig. 141 5

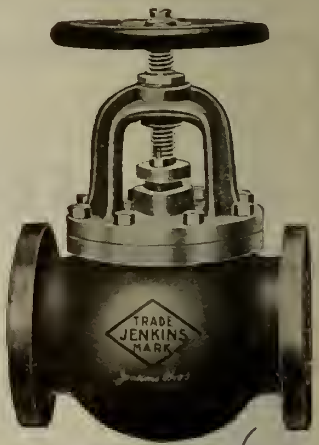


Fig. 142 6

The genuine JENKINS BROS.' VALVES are stocked by first class dealers everywhere.

Send for Catalogue 8.

TRADE JENKINS MARK Jenkins Bros **Jenkins Bros. LIMITED** TRADE JENKINS MARK Jenkins Bros 5
103 ST. REMI ST. MONTREAL

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C.A.S.E. Convention Headquarters, July 24-28, 1916

MEET US THERE

We extend a hearty invitation to visiting delegates to inspect our exhibit and make our booth their headquarters during their stay in Montreal.

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HIGHEST EFFICIENCY
COMPLETE SATISFACTION

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WATER-WHEELS
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Starrett TRADE MARK REG. U.S. PAT. OFF. **Heavy Micrometer**

UNIFORMITY, accuracy and durability are the important features in the tools that a shop must furnish. The Starrett reputation has been earned by producing tools and instruments of reliability. Micrometers, surface gages, hack saws for hand frames or power machines and many other tool-room supplies are described in the catalog.

Write for Free Catalog No. 21 CD.

BY INVITATION MEMBER OF
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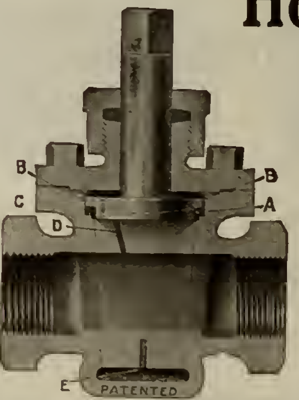
STARRETT TOOLS
TRADE MARK REG. U.S. PAT. OFF.

The harder the service, the more you need the "Homestead" Quarter Turn Valves



When the Homestead Valve is fully opened the two surfaces which are depended upon for tightness are in no way affected by the material passing through.

The plug cock provides a straight-way opening, which is desirable in all sorts of work, but is particularly important in high-pressure service. It is very useful when thick, heavy liquids are handled.

Homestead Quarter-Turn Valves open and close easily. The patented balancing parts insure this valve against sticking. The Homestead Valve embodies all details of safety, economy and efficiency.

Homestead Valve users include the largest mills, mines and railroad companies in the world

SEND A TRIAL ORDER. ONCE KNOWN ALWAYS USED

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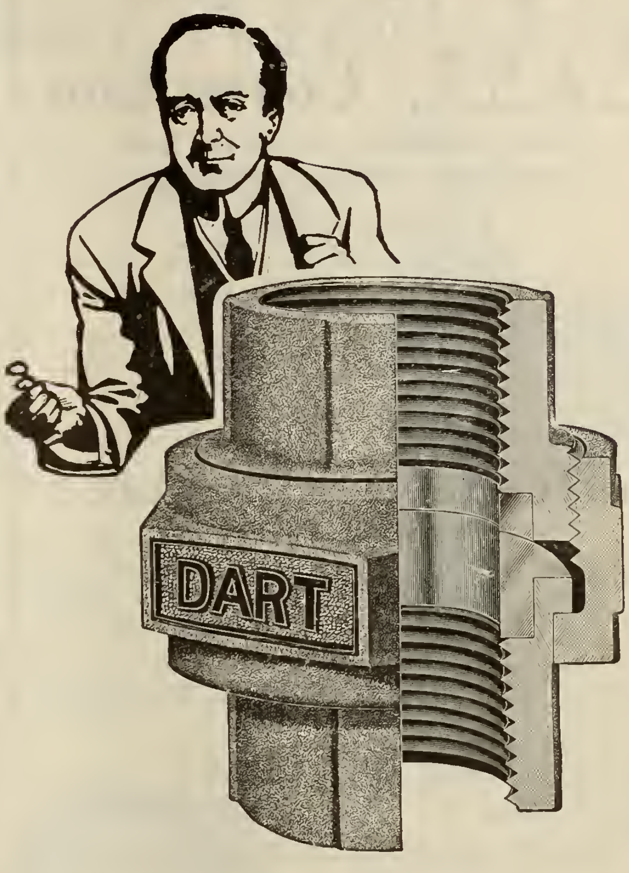
PITTSBURGH, PA.
Works: Homestead, Pa.



Bronze to Bronze at the Joint

Make EVERY Pipe Joint PERMANENTLY Tight

by Using

"Dart" Union Pipe Couplings

The Dart's efficiency is permanent because the face and seat are of Bronze, which, you know, will not rust or corrode, and these faces being surrounded by *HEAVY* iron parts ensures no breaking, stretching or pulling apart under strain or heavy pressure.

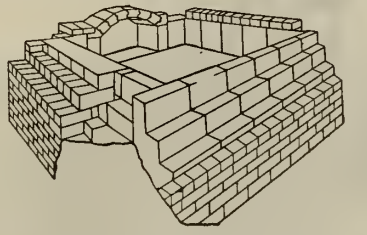
The use of Dart Unions eliminates upkeep cost and loss from leaks, and it means a saving of time, because the connection is easily and quickly made, whether pipes are in or out of line.

SOLD BY ALL DEALERS.

Manufactured by
DART UNION CO., Limited
Toronto, Canada

See Our Exhibit at the C.A.S.E. Convention

If not attending, write for full particulars and names of users.



Gates Boiler Furnace

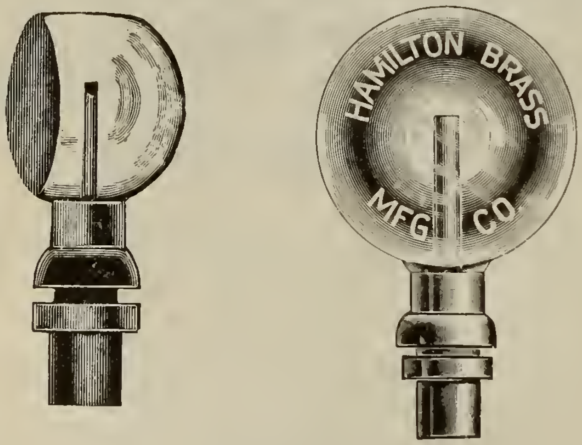
Patent Applied For

This furnace will last three times as long as ordinary good fire-brick. These blocks are interlocking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work. Think what that means in time and labor-saving in your own plant.

If you are attending the Convention, call around at our exhibit and let us explain to you fully—a sample furnace will be set up. There is no obligation — we want to get acquainted with you.

John W. Gates

382 St. James St. MONTREAL P.Q.


HAMILTON BRASS MFG. CO.

AUTOMATIC

SHAFTING OILERS

$3.00 per Dozen

Great Saving of Oil, Labor and Attention

FEED STARTS WHEN MACHINERY STARTS
FEED STOPS WHEN MACHINERY STOPS.

Write for our Catalog of ENGINE FITTINGS.

HAMILTON BRASS

Mfg. Co., Limited
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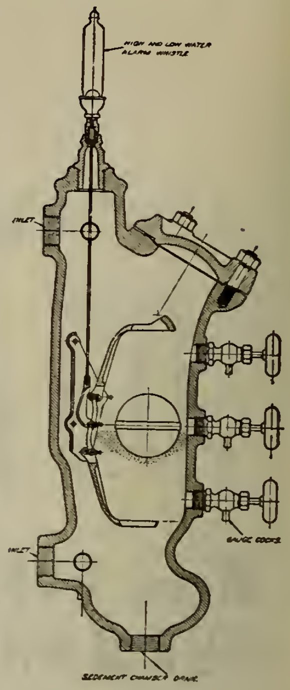
With High and Low Water Alarm

Exterior



Cross Section

WATER IN YOUR BOILERS CANNOT RISE ABOVE OR FALL BELOW THE DANGER LINE WITHOUT YOUR RECEIVING THE WARNING WHISTLE IF YOUR BOILERS ARE EQUIPPED WITH

The "Anderson" Safety Water Column

This device is positively reliable and efficient—the working parts cannot rust or stick.

The entire mechanism is assembled as a single unit in an independent, removable hanger frame hung on accurately machined pivots.

Write for full details.

The V. D. Anderson Co.

West 96th St., Cleveland. Ohio

We Are Canadian Agents For

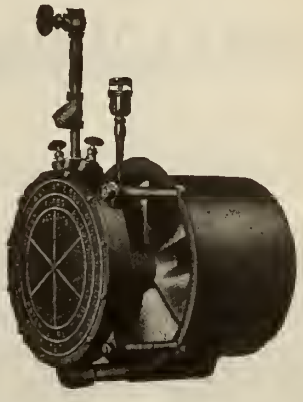
"BUNDY"

Return and Separating Steam Traps

"COPPUS"

Turbine Blowers for forced draught.

The most economical and efficient undergrate Blower



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COPES Feed Water Regulators

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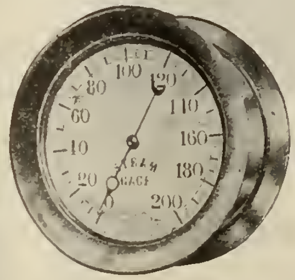
Reducing Valves

Pump Pressure Regulators

Damper Regulators

Automatic Pressure Control for all Conditions



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WATEROUS Engines

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We are prepared to furnish every sort of Power Plant Equipment.
Catalogues and full information are at the disposal of every engineer.

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You can get a steady steam pressure, regardless of your loads—you can burn less coal, and cheaper coal—

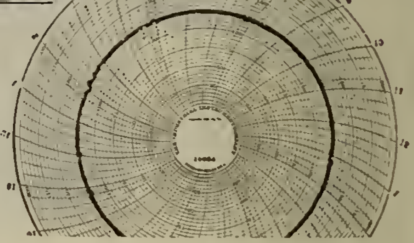
After you install a

JONES UNDERFEED STOKER

The worth of Jones Stokers has been firmly established for more than twenty years. They have been used in every line of industry where a regular and dependable supply of steam is essential—and **have effected big savings in the cost of firing and reduced fuel cost from 15 to 25%** in plants like your own.

"Jones" Stokers are extremely simple. There are very few working parts and none moving in contact with the fire. There are no grates; no losses through grates.

Let us describe "Jones" Stokers in detail. Send for illustrated catalogue.



Jones Underfeed Stoker
Company, Limited
National Trust Building TORONTO

Wasted Power
and
Wasted Labor

THE man who used a steam hammer for cracking nuts was wasting power. In these days the folly of wasting power is universally admitted and condemned. As a result, there is a large and continuous demand for labor-saving devices of all sorts.

WE are manufacturers of complete plant for the automatic and expeditious handling of coal and ash, and are prepared to submit, free and under specific guarantees, detailed schemes covering any boiler house plant from the simplest to the most complex.

"BENNIS" Machine Stokers, Coal Bunkers, Elevators and Conveyors are in successful operation in Munition Factories; in all progressive Electricity Stations, and in the leading industries throughout the world. Write to-day for particulars of recent installations and see what YOU can save in coal, men, boilers and money.

The G. H. TOD CO.

10 Croft St.
TORONTO

801 Union Bank Bldgs.
WINNIPEG

"We've got to save our concrete floors"

"Our cement floors are comparatively new and are the best we could lay down, but the surface is already sanding, water is getting spilled on them and they are soaking up oil. I tell you, gentlemen, we have got to save them."

R.I.W. REMEMBER ITS WATERPROOF REG. U.S. PAT. OFF. **CEMENT FILLER & CEMENT FLOOR PAINT** PATENTED AS TO PORTLAND CEMENT FEB.27,1906

will keep cement floors wearproof, waterproof and oilproof.

Scuffed off dust won't float in the air to ruin merchandise, get into bearings and cause electric motors to spark.

Oil won't get in, never to be gotten rid of, to injure the concrete

R. I. W. Cement Filler and Cement Floor Paint fill up the sandy, porous surface and prevent all wear on the floor itself.

Twelve standard shades.

Let us mail you a special booklet. Address Dept. 59.

Manufactured in Canada by
R.I.W. DAMP-RESISTING PAINT CO.
TOCH BROTHERS
Gerrard St. and Carlaw Ave.
TORONTO, ONTARIO, CANADA

Mention this paper when writing advertisers. It will identify the proposition about which you require information.

Murphy AUTOMATIC Furnace

Six Well-Known High-Class Canadian Corporations

Executed TWENTY CONTRACTS for Murphy Furnaces. (14 repeat orders—56 furnaces—18,664 nominal H.P.)

X indicates REPEAT ORDERS in 1916 !

LAURENTIDE PAPER COMPANY (11 years' experience), Grand Mere, P.Q.

1st order,	March, 1905	9 furnaces,	2300 HP.
2nd "	July, 1907	2 "	700 HP.
3rd "	April, 1912	2 "	800 HP.
4th "	May, 1912	1 "	400 HP.
X5th "	May, 1916	1 "	400 HP.
		15 furnaces,	4600 HP.

SPANISH RIVER PULP & PAPER CO., Espanola, Ont.

1st order,	April, 1911	4 furnaces,	1120 HP.
2nd "	January, 1913	2 "	600 HP.
X3rd "	March, 1916	2 "	600 HP.
		8 furnaces,	2320 HP.

LAKE SUPERIOR PAPER CO., Sault Ste. Marie, Ont.

1st order,	July, 1911	13 furnaces,	4250 HP.
2nd "	June, 1912	2 "	1000 HP.
X3rd "	April, 1916	1 "	500 HP.
		16 furnaces,	5750 HP.

ONTARIO PAPER COMPANY, Thorold, Ont.

1st order,	Sept., 1912	4 furnaces,	1332 HP.
2nd "	Aug., 1914	1 "	330 HP.
X3rd "	Feby., 1916	2 "	666 HP.
X4th "	April, 1916	2 "	666 HP.
		9 furnaces,	2994 HP.

DONNACONNA PAPER COMPANY, LTD., Donnaconna, P.Q.

1st order,	Feby., 1913	2 furnaces,	600 HP.
2nd "	June, 1913	1 "	300 HP.
X3rd "	March, 1916	3 "	900 HP.
		6 furnaces,	1800 HP.

BEAVER FIBRE BOARD CO., Thorold, Ont.

1st order,	May, 1913	2 furnaces,	600 HP.
X2nd "	Feby., 1916	1 "	300 HP.
		3 furnaces,	900 HP.

THERE MUST BE A REASON—for the 14 REPEAT ORDERS !

If you want to profit by their experience, write to-day for catalogue and list of Canadian installations.

MURPHY IRON WORKS, DETROIT, MICH.
BUFFALO, N. Y.

GARLOCK PACKING

For High Pressure Steam Rods
Use Garlock Style No. 200

For Medium Pressure Steam Rods
Use Garlock Style Number 446

For Low Pressure Steam Rods
Use Garlock Style Number 333

For Worn or Scored Piston Rods
Use Garlock Style Number 336

For Cold Water Piston Rods
Use Garlock Style Number 99

For Inside Packed Plungers
Use Garlock Style Number 260

For Outside Packed Plungers
High Pressure Hot Water
Use Garlock Style Number 1907

For Outside Packed Plungers
High Pressure Cold Water
Use Garlock Style Number 960

These Packings are Guaranteed to Give Satisfactory Service Under the Above Mentioned Conditions

THE GARLOCK PACKING COMPANY
HAMILTON, ONTARIO
Branches in Principal Cities

"Jim won't be home for supper to-night"

Thousands of "Jims," "Bills," "Toms" and "Mikes" know what it means to have their suppers wait or get none because of the failure of their rod packings to make good, with the result that a nice, hot job of re-packing stares them in the face after a full day's work. If you are one of these "boys," you can end your troubles by using—

DANIEL'S ROD PACKING

P.P.P.

FOR STEAM, AIR, WATER, AMMONIA

Reg. U S. Pat. Off.

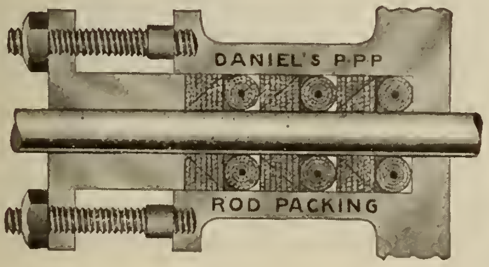


Fig. 5

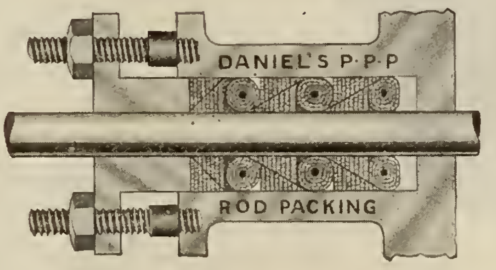


Fig. 6

Positions of MARINE P. P. P. Packing in the Stuffing-box of a High-pressure, Non-condensing Engine using Very Dry or Superheated Steam.

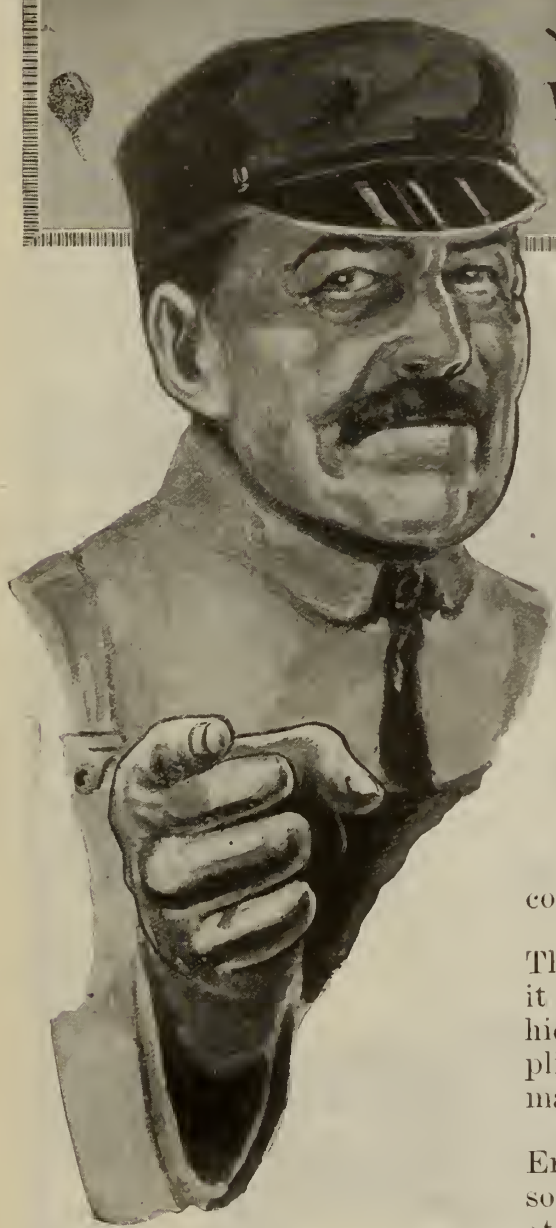
Fig. 5 shows the Packing properly placed in the box, with the gland resting easily on the top ring. After the steam has been turned on, tighten slightly if there is leakage.

Fig. 6 shows the slide of the wedges under pressure, and the varying degrees of compression of the cushions —that of the middle one less than the bottom, and the top one less than the middle, making possible sufficient additional compression for the packing to further adjust itself to increased requirement.

Your dealer can supply you with the GENUINE Daniel's P. P. P. Rod Packing, but if he will not, then, write direct to the factory for the name of a nearby supply house that will give you what you want.

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS
PHILADELPHIA, PA., U.S.A.



"Belting trouble ends where D. K. McLaren's Belting begins"

Freedom from belting troubles such as break-downs, loss of power, slippage, stretch, etc., is ensured the instant you give

D. K. McLaren's

Genuine British Oak-Tanned

Leather Belting

control of your power transmission problem.

The secret of the success of this belting lies in the fact that it is under the supervision of experts, from the selection of hides till the final finishing touch (the trade-mark) is applied—and that our genuine British Oak method of Tanning makes leather exceptionally tough, durable and pliable.

Engineers who use D. K. McLaren's Belting say that it runs so well that they hardly realize that they are using belting at all. And it certainly does give the longest service of any make on the market.

Let us put you in touch with a few out of many satisfied users—and be guided solely by what they tell you.

GENUINE OAK

REGISTERED TRADE MARK

MANY OF THE LARGEST POWER PLANTS IN THE COUNTRY ARE OUR STEADY CUSTOMERS.

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LIMITED

Head Office and Factory: 351 St. James St., Montreal, P.Q.

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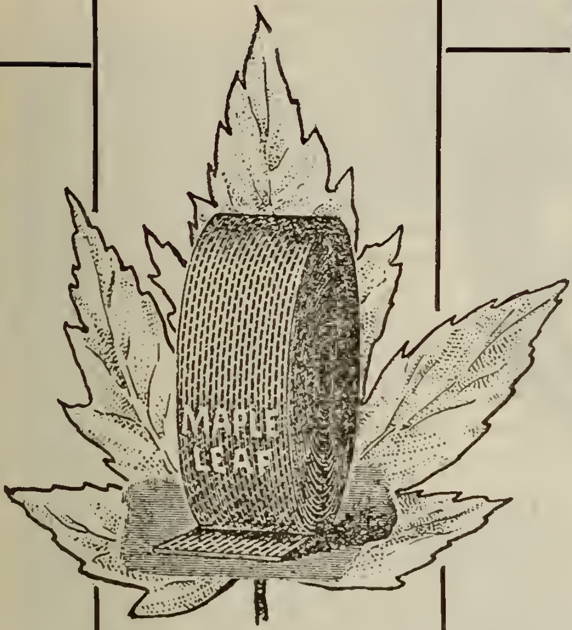
VANCOUVER, B.C.
847 Beatty St.

ENGINEERS SUPPLY CO., 123 Bannatyne Ave. East, Winnipeg, Man.



MAPLE LEAF BRAND

Stitched Cotton Duck

BELTING

Drives Down Belting Costs

It possesses unusual strength and durability. At a recent test Maple Leaf Brand Belting stood a breaking strain 50% greater than leather and 25% greater than rubber.

It grips the pulley with the highest efficiency and is absolutely true running.

Costs less than Leather, Rubber or Balata Belting.

A trial belt will convince you.

Write for samples and prices.

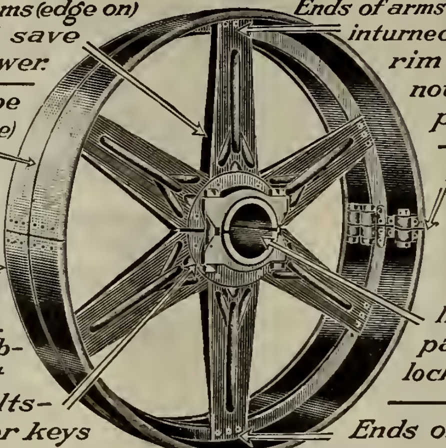
MAPLE LEAF BELT DRESSING
The Best for all Kinds of Belts

If you cannot attend the C.A.S.E. Exhibition at Montreal, write us for samples and prices.

Dominion Belting Co., Ltd.

HAMILTON, CANADA
Quebec Branch—51 Duluth Building, Montreal

The Most Efficient Pulley


Flat "A" braced arms (edge on) cut the air and save enormously in power.
Grooved air escape (an exclusive feature) diminishes air cushion under belt.
A rim made like a channel iron central flanges and safety beaded edges.
The only correct crown
All steel parting hub-clamped to shaft with powerful bolts-no set screws or keys required.
Ends of arms solidly riveted to inturned strengthening rim flanges-Arms not riveted through pulley face.
A parting pulley-no occasion to strip shaft. Rims doweled together at bead.
Interchangeable parting bushings locked to pulley hub.
Ends of arms all milled to exact length.

STUDY the chart and see why the "**AMERICAN**" is the most efficient.
There is no secret about it, and we can prove our claims to the satisfaction of the engineers.
We welcome an investigation, and are grateful for an opportunity to show the real facts.
Minimum belt slip—less than with cast iron or wood pulleys.
Minimum loss of power through windage. Maximum strength for least weight.
No set screws and no key ways, except in unusual cases. Interchangeable bushings.

The American Pulley Company, 4234-60 Wissahickon Ave., Philadelphia, Pa., U.S.A.
Williams & Wilson, Limited, Montreal
The A. R. Williams Machinery Co., Limited, St. John, N.B., Toronto, Winnipeg, Vancouver

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

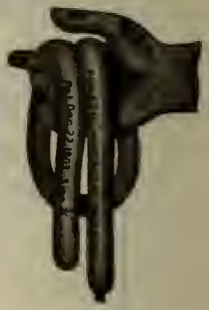
LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

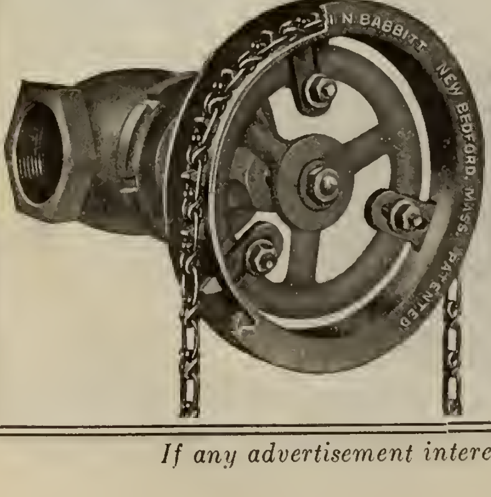
Send for **FREE SAMPLE** and particulars.

MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless



Any Quantity sent on APPROVAL



They Thought Two Would Do

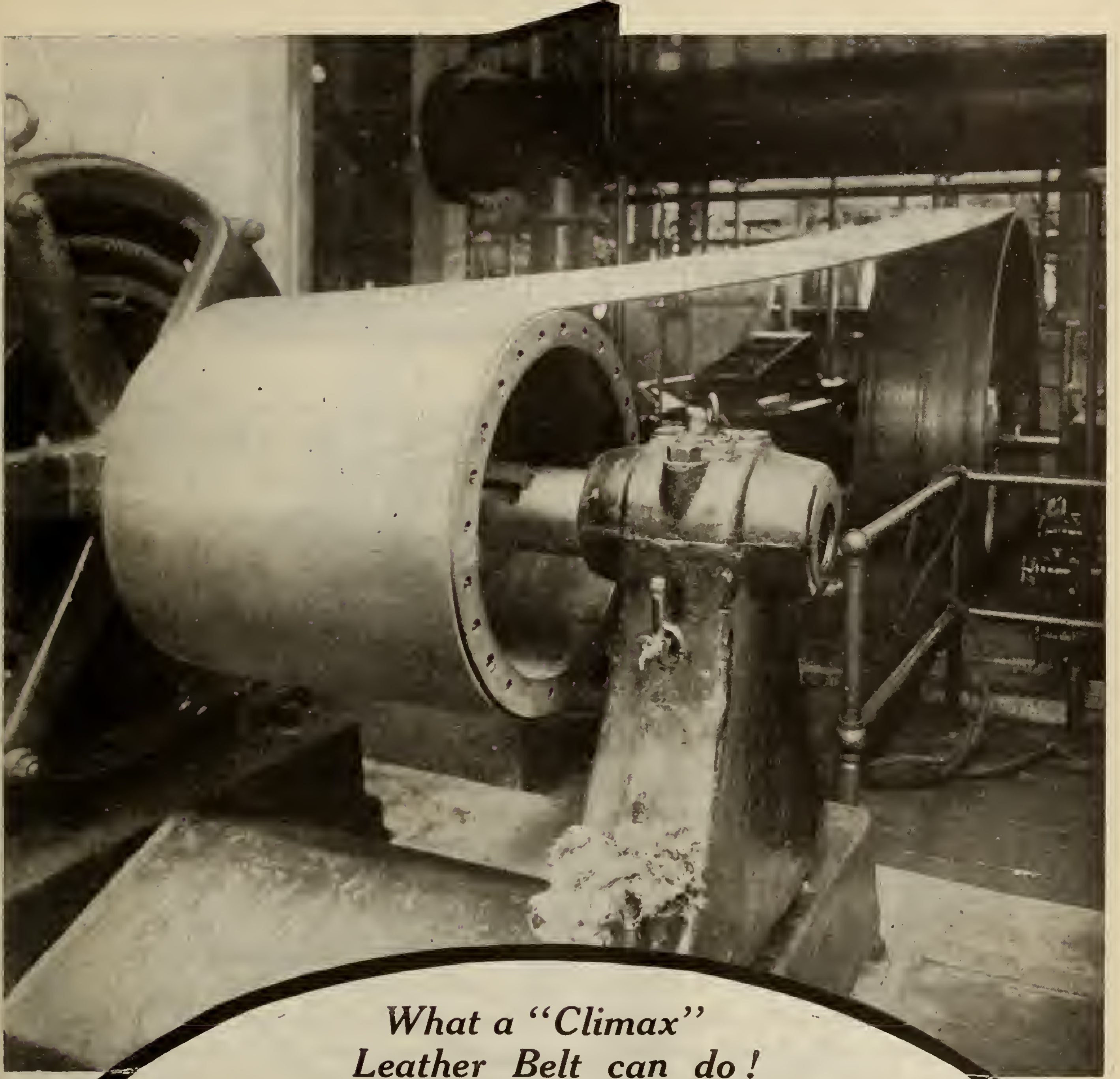
in a certain big New England mill, because mill and equipment were brand new and strictly modern.

But They've Bought Just 27 of These

Babbitt Adjustable Sprocket Rims

since July 1st. Like this: July 1, two; July 20, two; July 23, six; Aug. 25, eight; Sept. 8, nine. That's the way they go, because everybody recognizes them on sight, as "Just the thing they have been looking for, but did not know where to get it." Easy to put on—goes right on your present valve wheel—easy to pay for. Ask your dealer. Send for Illustrated folder.

Babbitt Steam Specialty Co., 59 So. Water St., **New Bedford, Mass.**



What a "Climax"
Leather Belt can do!

28" Double Sadler & Haworth Leather Belt

Connecting 225 H.P. Allis Chalmers Bullock Motor, 600 rev. per min. to Ingersoll Rand Air Compressor, in the plant of the P. Lyall & Sons Company, Montreal, Quebec.

Cyl. dimensions:—high pressure 18 x 24 inches, low pressure 22 x 24 inches .
150 revs. per minute, working against a pressure of 110 lbs. per sq. in. for 24 hrs. a day.
Capacity of compressor 1,600 cu. ft. per minute.
Dis. of pulleys: motor 28 inches.
Compressor 10 feet.

Approximate belt speed 3,800 ft. per minute.
Service and the cost per day of this service, is the time basis of belt value.
Sadler & Haworth Belts cost less per day of service. This fact renders them the least expensive irrespective of any comparisons of first cost per foot length.
Try a drive and see.

St. John, N.B. —89
Prince William St.

Sadler & Haworth

TANNERS AND MANUFACTURERS
For over 40 Years the Makers of the Best Leather Belts

38 Wellington St. East
Toronto, Can.

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Montreal, Can.

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and Bannatyne Sts.

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Cost less per day *Cost less per day*

What Make of Chain?

SOONER or later, in your plant, a power transmission problem will bob up where nothing but a chain drive can be used. Regardless of your opinions now, or then, there are cases of that kind and the selection of a certain make of chain is then a necessity.

Chain driving is not limited to applications where nothing else can be used. Its use is not confined to certain industries. Its qualifications for efficiently and economically transmitting power are general—applicable anywhere.

MORSE Chains are most generally selected for large as well as small drives because of that important and exclusive feature, the "Rocker-Joint."

1,500,000 horsepower of MORSE "Rocker-Joint" Chains are today giving satisfactory service in practically every power using industry. This includes, without doubt, the first, second, third and fourth largest chain drives in the world, and probably the first ten largest drives.

From the monster chains of 3-inches pitch by 24-inches wide, sizes extend downward to 3/8-inch pitch by 3/4-inch wide, and the "Rocker-Joint" is of exactly the same design in them all.

Wouldn't it be much better to find out all about chain driving now than to wait until the selection of a certain make is unavoidable?

Preparedness is the popular subject just now, and the beauty of being prepared in this case will in all probability disclose other instances where a chain drive, while not absolutely necessary, would be both highly desirable and economical.

Literature and information furnished upon request.

MORSE CHAIN CO., ITHACA, N. Y.

"MORSE" Of Course

S-10

MORSE CHAIN COMPANY ITHACA, NEW YORK

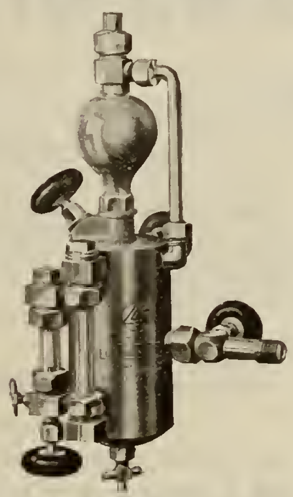
Detroit Lubricators

Give

Constant, Even Temperature and Rate of Feed

The cored heating passage, cast with the body and lending strength to same, is filled with steam while in operation. The heat keeps oil in a thoroughly liquid condition, making it possible to feed heavy oils. The temperature maintained is even and there is therefore no fluctuation in the rate of feed. Easy filling without waste and delay resulting from bubbling is another feature. Write for our catalog. Sent on request.

Look for our Trade Mark when in the buying mood.



Efficiency
Holds
Over Half
The World's Trade

Makers of the Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

FORTY-EIGHT YEARS OLD

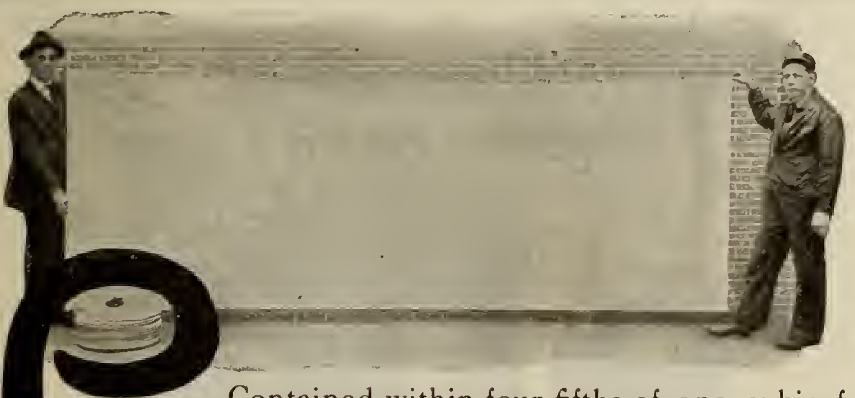
with a record of increasing the lubrication efficiency and lowering the cost.

ALBANY GREASE

should be used in your plant all of the time. Write us for testing samples.

Your dealer sells Albany Grease ; if not, order direct

Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868



55 Sq.Ft. Effective Filtering Surface

Contained within four-fifths of one cubic foot—the cloth is arranged so that every inch of the 55 square feet is available, yet it occupies a space about 5 inches high and 19 inches in diameter.

The Bowser Filtering Section is a wide departure from the usual method and embodies more active working surface—almost 29 times more—than is possible to put in any other method of construction in the same space.

BOWSER ESTABLISHED 1885 Central or Individual Oil Filtering Outfits

with capacities from 5 to 7,000 gals. or more of filtered oil per day. Scientific, wasteless and practical filtration is the work of specialists—and we are specialists both from the engineering and manufacturing standpoint.

We make equipment for Storing, Measuring, Circulating and Clarifying oils of all kinds—volatile, non-volatile, lubricating or paint.

Put your Oil Problem up to us—No obligation incurred.

S. F. BOWSER & CO., Inc., Fraser Ave., Toronto, Can.

Sales Offices in all Centers and Representatives Everywhere

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TRADE MARK

TRADE MARK

A NAVAL OFFICER'S OPINION

U. S. S. DOROTHEA,
OHIO NAVAL MILITIA,
CLEVELAND.

January, 18, 1916.

Magnolia Metal Co.
Gentlemen:

I have your letter of the 16th inst., and beg to advise that I had occasion to use Magnolia Metal in rebabbitting eccentric straps of the main engine of this vessel, which is a 1558 I. H. P., triple expansion engine, turning 170 R.P.M. The exceptional quality of the metal was shown by the fact that the straps were rebabbitted, and that we got under way for a three-day cruise without previous working down of bearings. They did not even get warm, and worked as cool as old bearings throughout the entire cruise. The fact that the bearings were set up to .012 makes the above record a good one.

Very truly yours,
GEO. W. BILLINGTON,
Lieut. Engineer Officer, O.N.M.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c. post paid.

Address Montreal Office.

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MAGNOLIA METAL CO.

OFFICE AND FACTORY:
225 St. Ambroise St. MONTREAL

Sliptivity Steam Cylinder
Sliptivity Steam Engine
Automobile Cylinder

OILS

These highly efficient lubricants go a long way and will greatly add to the life of your machinery.

They are a triple combination that's hard to equal. A trial will convince you of this fact and create a desire for more.

USED OVER THE ENTIRE WORLD.

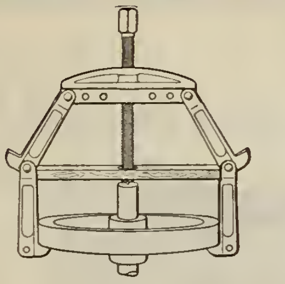
Our prices are very reasonable for that of good quality.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating **and** Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, **Disinfectants,** Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Streets, P.O. Box 1984. **Vancouver**—823 Powell Street. **Calgary**—1810-1840 Eleventh St. East, P.O. Box 1384, P.O. Drawer 166. **Edmonton**—Cor. 13th Ave. and 83rd St., P.O. Box 877.

CRANE'S New Model Patent Wheel Puller



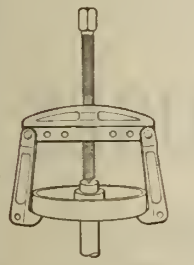
**For Removing Transmission and Cam Shaft Gears, Auto Wheels, Fly-Wheels, Sprockets, Collars, Couplings, Propellers, Universal Joints—
For Straightening Shaft, Bending Pipe, Etc.**

Work of Large Diameter (a piece of wood being used as a spreader)

The screw has a flat end with inserted tempered tool steel point, that will not spread cutters. Makes its own centre on work that has none. The strain is taken on the flat end of the screw. Grease to keep from cutting. The screws are made of high carbon steel and case-hardened all over. All pullers are furnished with two sets of the new combination hook extension arms.

The Pipe-Bending Attachment consists of a pair of arms and forked end for the screw.

Write for full particulars.



Removing Work Near End of Shaft

The Crane Puller Co.

54 Lake Street
ARLINGTON, MASS., U. S. A.

Canadian Distributors: Canadian Fairbanks-Morse Co., Montreal, Toronto, Vancouver, Winnipeg, St. John, Calgary; John Millen & Son, Montreal, Toronto, Winnipeg, Vancouver.

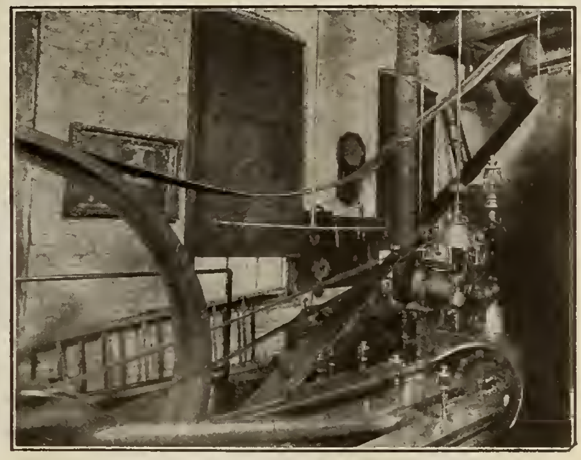
Simplicity and Economy in Ashes Handling with the Jeffrey "Reliance" Drag Chain Conveyer.

In addition to the small amount of space occupied by the conveyer, and the low first cost of the chain itself, maintenance costs are reduced to the very minimum, because a film of finer material acts as a cushion or wearing surface between the chain and the trough.

Illustrated Bulletin No. 154-4 brings out the merits of some interesting installations. Send for copy.

The Jeffrey Mfg. Company,

Canadian Branch & Warerooms, MONTREAL.



If You Could Make a Safe Legitimate Investment of $100.00 Bring You Back $200.00 in a Year's Time, Would You Do It?

We would and we think *you* would. However, the mere doubling, tripling or quadrupling of money doesn't begin to touch the possibilities from Cling-Surface.

As we recently showed you, Cling-Surface treatment of belting can be the direct means for saving from $90.00 to several thousand dollars per year by reducing transmission friction in belted plants of from 50 to 1,000 h.p. Considering the very small expenditure for a few pounds of Cling-Surface and considering the large return, what better investment could you make?

An example: The 10-inch belt in the plant of the Aird-Don Co., Troy, N.Y., as shown in the picture, transmits 40 h.p. from a 14-foot to a 30-inch pulley on 30-foot centers. The engineer here, Mr. Louis J. Landmeir, tells us that scientific treatment of this belt with Cling-Surface costs him only 90 cents per year. Then he goes on to say:

> *"Belt has had Cling-Surface treatment about 3 years. Is very pliable. No trouble with lacings pulling out or with belt slipping. Never have to take up belt. Used various belt dressings, but never had such success as with Cling-Surface."*

Can you imagine how 90 cents could have been spent to better advantage?

Don't you think Cling-Surface worth investigating? Are your belts pliable? Do they run slack like the one in this picture? Do they pull maximum loads without slip? Are they waterproof? Durable? Troubleless?

They would be under Cling-Surface treatment.

Proof of all our claims awaits your inquiry.

We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

Cling-Surface Co

1057 Niagara Street
Buffalo NY

I am interested in Cling-Surface and your trial order proposition.

Name.............................. Position..................

Firm ....

Street ....

City.............................. Province..................

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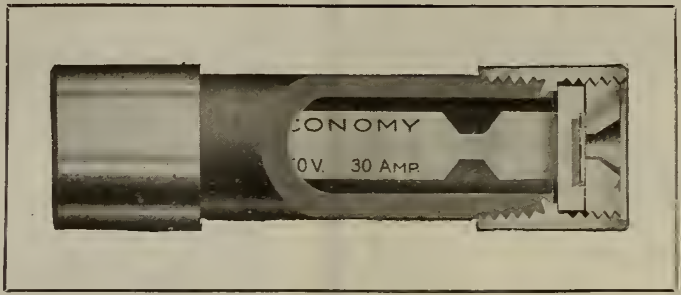
If any advertisement interests you, tear it out now and place with letters to be answered.



For the especial consideration of C. A. S. E.

ECONOMY renewable cartridge FUSES

are made in Canada and sanctioned by the Canadian Fire Underwriters' Association.

The stationary engineer who purchases or specifies electrical material, has the means at hand to cut down annual fuse maintenance expense fully eighty per cent., while providing more than adequate protection for his plant. The use of Economy Fuses effects this saving, as attested to by engineers here and in the States.

There are thousands of Economy Fuse users and millions of Economy Fuses in use. The are specified and installed for two chief reasons: SAFETY FIRST—ECONOMY NEXT.

Why don't you cut your fuse costs four-fifths. Such a saving will be noticed and appreciated.

Free samples of any desired types and capacities sent with catalog 24. List of prominent users included.

ECONOMY FUSE & MFG. CO. of Canada, Limited

Unity Building MONTREAL

Manufacturers in Canada of "S. & C." High Potential Fuses — to 150,000 Volts.

"New Departure" Ball Bearings

For Autos, Motor Trucks and Machine Tools

"New Departure" Ball Bearings are produced in the largest ball-bearing manufacturing plant in the world, and are used in over 75% of the motor cars on this Continent.
The "New Departure" line is most complete, comprising the regular annular single row ball-bearings, cup-and-cone or "take-up" bearings, and the

"New Departure" Double Row Ball Bearing

This is a distinctive "New Departure" design that in a single unit combines the greatest capacity for carrying all loads from any direction. It will take radial loads 1-3 to ½ greater than will a single row bearing of the same bore and diameter —a thrust, when no other load is present, of nearly twice its radial load capacity— or a combination load many times greater than that of a single row bearing.

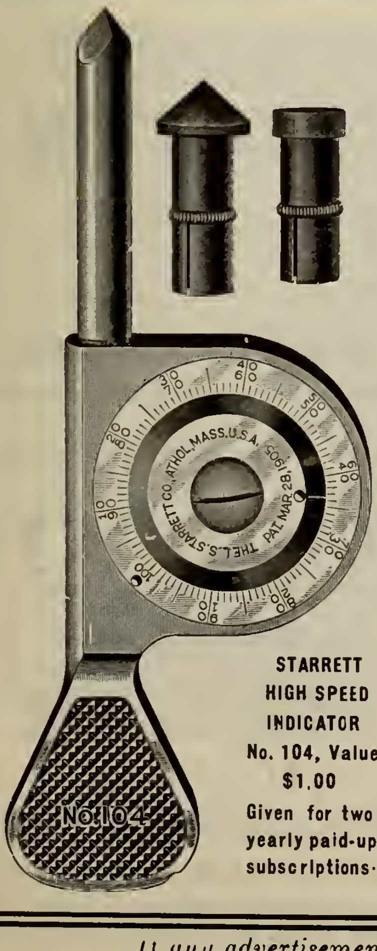
This double function makes it the most efficient and economical anti-friction bearing for 75% of the places where ball bearings can be properly installed.

Write for Catalogue and full information to

Lyman Tube & Supply Company, Limited

MONTREAL
323 St. James Street

TORONTO
33 Melinda Street


THE L.S. STARRETT CO. ATHOL, MASS. U.S.A.
PAT. MAR. 28, 1905
No. 104

STARRETT HIGH SPEED INDICATOR
No. 104, Value $1.00
Given for two yearly paid-up subscriptions.

You May Have This Speed Indicator without Spending a Cent

if you are a subscriber to "THE POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

"THE POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools

THE POWER HOUSE **143 University Ave., Toronto**

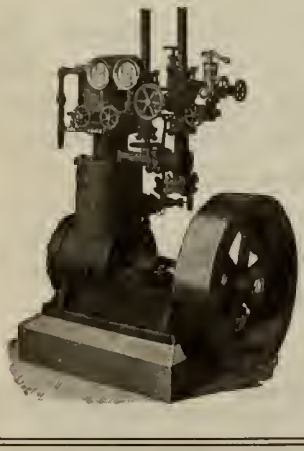
REFRIGERATION DEPARTMENT

A COOLING SUGGESTION

IT'S NOT TOO LATE TO INSTALL YOUR REFRIGERATING PLANT FOR THIS SEASON'S REQUIREMENTS, NEITHER IS IT TOO EARLY TO CONSIDER THE EQUIPMENT YOU WILL NEED TO COPE WITH THE EARLY ORDERS NEXT SPRING.

THE
LINDE CANADIAN REFRIGERATION
COMPANY, LIMITED
37 ST. PETER STREET, MONTREAL

THE ONLY REFRIGERATION COMPANY MANUFACTURING IN CANADA



Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones. AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Corliss Engines *Special Machinery*

THE VILTER MANUFACTURING COMPANY
242 Beecher Street, MILWAUKEE, Wis. *Chicago Office:* 731 Monadnock Building

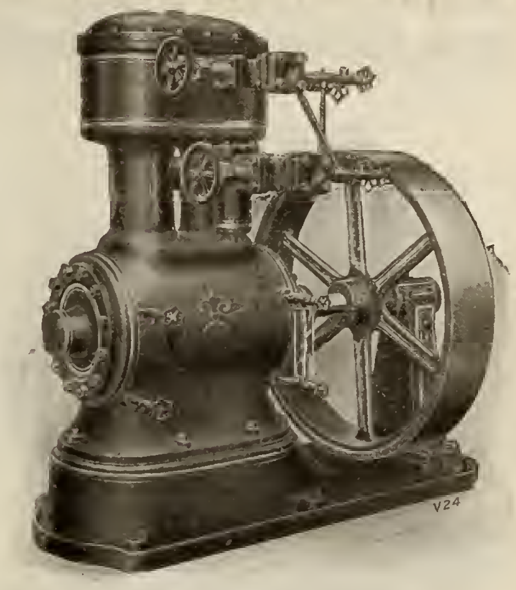
The Big Question

before the buyer of a small refrigerating plant is—not how cheaply he can buy—but how much real service and reliability he can get.

The Frick Enclosed Machine embodies the same high class construction that has given all Frick machinery an unequalled reputation for

Reliability and Lasting Service

Write us for full particulars. They're yours for the asking.



Frick Company
WAYNESBORO, PA., U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:
THE FRICK ICE AND REFRIGERATION COMPANY, 357 St. Catherine Street West, Montreal

DOORS

For Cold Storage and Freezer Purposes Either Standard or Fireproof

JAMISON'S "JONES" and "NOEQUAL" doors are SUPERIOR because:

1st—Only the best materials are used in their construction.
2nd—We use heavier materials. Result: Longer life and increased efficiency.
3rd—Our doors are built with double and triple seals of contact—others have but one.
4th—Our Automatic Self-Tightening Fastener is the only truly AUTOMATIC and SELF-TIGHTENING Fastener on the market.
5th—Our ADJUSTABLE SPRING Hinges mean the door is always properly seated in the frame, making sagging impossible.

Write for General Catalog No. 7, illustrating and describing both "Jones" and "Noequal" doors, windows, ice doors and chutes, etc.

Jamison Cold Storage Door Company

Formerly Jones Cold Store Door Co. **HAGERSTOWN, MD., U.S.A.**

"Reports from practically all sections of the country declare that the ice harvest has been most unsatisfactory."

(Editorial)

Represented in the Dominion by

Canadian Ice Machine Company

MONTREAL - 626 Coristine Building
TORONTO - - - - 82 Chestnut Street
WINNIPEG - - - 85 Lombard Street

But this is not news. The *Natural* ice harvest is never satisfactory.

MECHANICAL REFRIGERATION

is always satisfactory, if installed the YORK way.

Then why continue using ice for cooling, when Mechanical Refrigeration is less expensive, more dependable, more sanitary and more satisfactory in every way? Be independent of the ice harvest.

We have a Branch Office near you, supervised by expert engineers, who will be glad to give you information and prices on a Refrigerating Plant best suited to your individual requirements. Shall we have them call?

York Manufacturing Company

(Ice-Making and Refrigerating Machinery exclusively)

YORK, PA., U. S. A.

Cheap Insulation or Economical Insulation—Which Will You Buy?

Some people buy cheap cold storage insulation and think they are saving money. They would be if cheap insulation were economical—but it isn't. The most economical insulation in the long run is the one that has a high insulating value, is durable and easy to erect. If you take these points into consideration when you buy, you will find

Nonpareil Corkboard Insulation

For all Cold Storage Rooms

the most economical on the market.

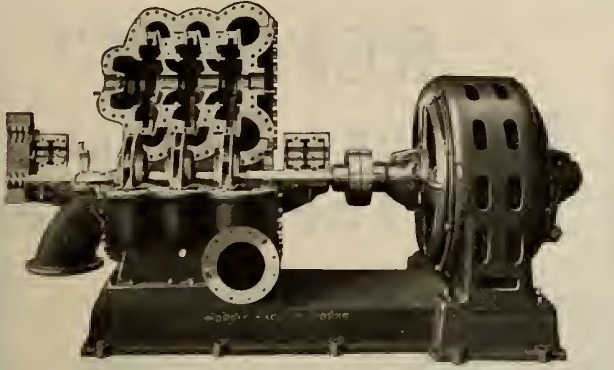
Nonpareil Corkboard is made of pure, granulated cork, compressed and baked in molds. It is an excellent nonconductor of heat and much less refrigeration is needed where it is used. It is practically moisture-proof, if properly erected, and will not mold or rot. This means it will last indefinitely and not lose its insulating efficiency after a few months' service. Nonpareil Corkboard is also easy to erect in all kinds of buildings. It is furnished in board form and can be handled, sawed and nailed like lumber. You can install it yourself or we will do it for you. Why not investigate Nonpareil Corkboard before you buy? It will pay you to do so.

Cold storage rooms of South Dakota Agricultural College, insulated with Nonpareil Corkboard.

Sample and full information on request.

Armstrong Cork & Insulation Co., 504 McGill Bldg.
LIMITED Montreal, Que.

Also manufacturers of Nonpareil Cork Covering for all cold pipes and Nonpareil High Pressure Covering for steam lines.



Reliable Pumps

When you buy a machine of any kind, you ought to take into consideration the maker's reputation and experience.

"Morris" Pumps have been manufactured for half a century and embody experience and careful workmanship with the most up-to-date practice in pump design.

The cut shows a horizontally split shell multi-stage pump with top half of shell raised for inspecting the interior, necessitating no breaking of pipe connections—altogether a most simple operation to get into it. We have a pump for every service.

STOREY PUMP & EQUIPMENT CO., **KENT BUILDING TORONTO, CAN.**

Canadian Sales Agents for

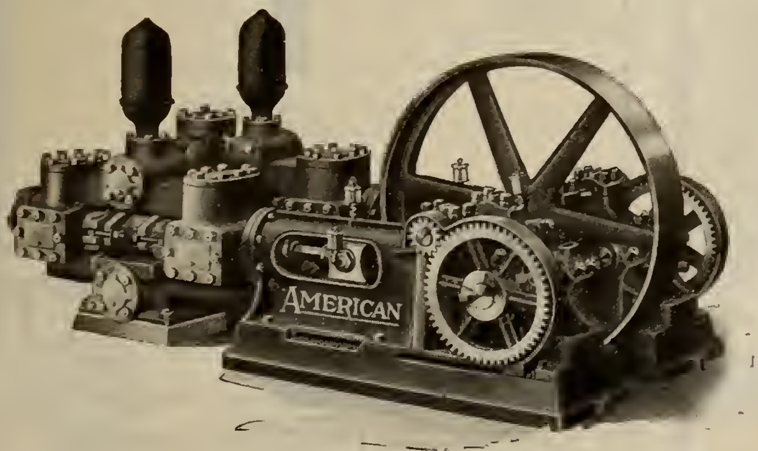
MORRIS MACHINE WORKS, BALDWINSVILLE, N.Y.

MARSH and AMERICAN

Pumping Machinery. Steam and Power Driven

The world has used and endorsed over 130,000 Marsh and American Pumps. Twenty-seven years of pump manufacture have proved our ability and perfected our facilities. Marsh and American Pumps are 100 per cent. correct—from the selection of raw material and accuracy of design to the actual pumping service, day in and day out, year after year. They ask no apologies and never have to explain away any error in service or failure in efficiency.

Investigate. Ask for our 250-page catalog illustrating and describing the line. Your pumping problems will be answered fully and satisfactorily through this investigation. This catalog will be sent by return mail in answer to your inquiry. Your copy is awaiting your prompt request.



American Duplex Belt-Driven Boiler Feed Pump. Outside Packed Plunger Pattern.

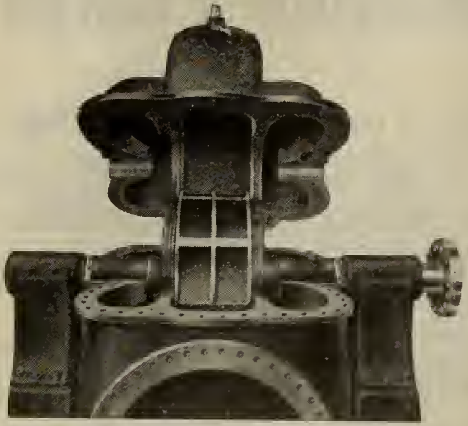
AMERICAN STEAM PUMP COMPANY

BATTLE CREEK, MICH.

CANADIAN AGENTS:

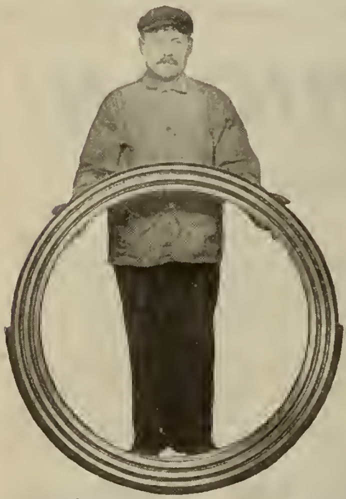
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.

One of the Most Important Parts of a Centrifugal Pump



De Laval Single-stage Pump with cover raised, giving access to all working parts.

A CERTAIN amount of clearance is necessary between the pump casing and the impeller at the impeller suction opening, but a straight joint allows much leakage, and, if the water contains grit or other solids, quickly cuts out. Leakage at this point in a centrifugal pump causes great loss in efficiency and may go on unnoticed for a long period.



De Laval Packing or wearing rings of the labyrinth type.

In the De Laval Centrifugal pump intermeshing labyrinth rings are employed, one attached to the pump casing and the other to the revolving impeller to insure maximum efficiency through minimum leakage and wear. Due to our limit gage method of manufacture, all parts are interchangeable. All interior parts of a De Laval Pump are at once accessible upon removing the casing cover and without disconnecting suction and discharge piping.

If you use pumps for any purposes, read our 300-page Treatise B. 61 on their "Design, Manufacture, Testing, Selection and Uses."

DE LAVAL

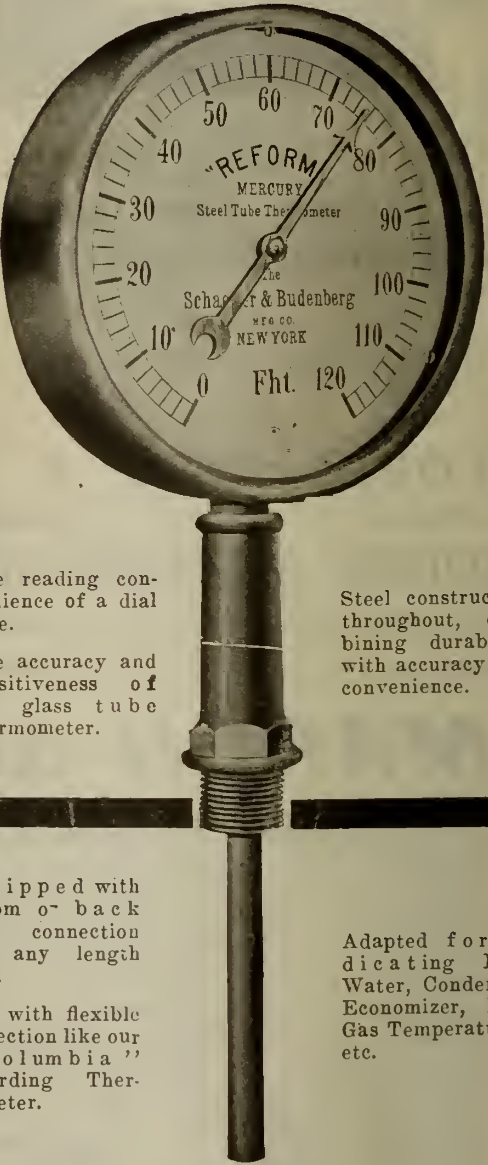
Reg. U. S. Pat. Office.

STEAM TURBINE CO., Trenton, New Jersey

Turbine Equipment Co., Limited, C. P. R. Bldg., Toronto, Can.
The E. Laurie Co., 243 Bleury Street, Montreal, Can.

213

"REFORM" Mercury Actuated Dial Thermometer



The reading convenience of a dial face.

The accuracy and sensitiveness of the glass tube thermometer.

Steel construction throughout, combining durability with accuracy and convenience.

Equipped with bottom or back rigid connection and any length stem.

Also with flexible connection like our "Columbia" Recording Thermometer.

Adapted for indicating Feed Water, Condenser, Economizer, Flue Gas Temperatures, etc.

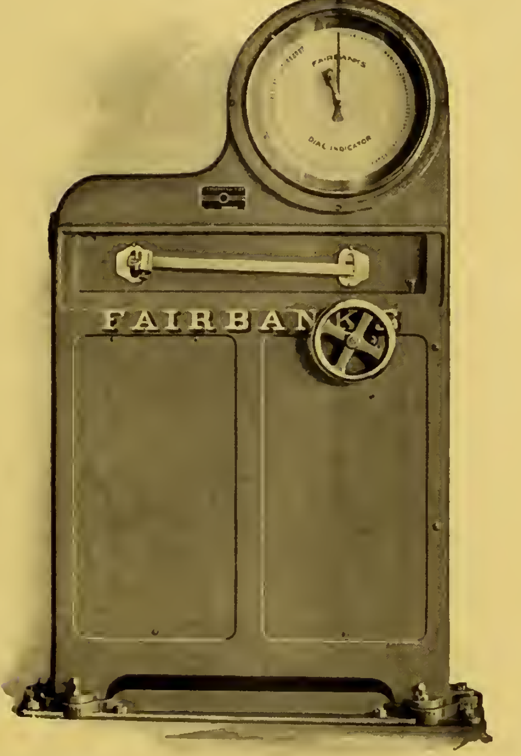
Ask for Pamphlet W-101

THE Schaeffer & Budenberg MFG. CO.

Makers of "Columbia" Recorders. "Crescent" Thermometers, S & B Gauges, Tachometers, Counters. Calorimeters, Indicators, etc.

Berry and South 5th Streets, Brooklyn, N. Y.

Also Chicago, Philadelphia, Pittsburgh.



Fairbanks Dial Indicator

(Direct Reading)

This Dial Indicator is the most highly developed Machine of its type for modern, quick-weighing service. It saves its owners hundreds of dollars in time, labour and increased accuracy.

Can be readily attached to any existing platform scale now in good working order; or can be supplied with scale complete.

Made in two sizes:

Dials graduated to 200 lbs. x 1 lb., and 1,000 lbs. x 5 lbs.

Total capacity 2,000 lbs. and 1,000 lbs. respectively.

Write for full particulars and prices.

- **Automatic Scales**
- **Computing Scales**
- **Fine Scales**
- **Counter Scales**
- **Platform Scales**
- **Dormant and Warehouse Scales**
- **Railway Track Scales**
- **Mine Scales**
- **Dairy Scales, etc.**

The Canadian Fairbanks-Morse Co., Limited

Fairbanks-Morse Service—From Coast to Coast

CFM

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

If any advertisement interests you, tear it out now and place with letters to be answered.

Correct Engineering Principles

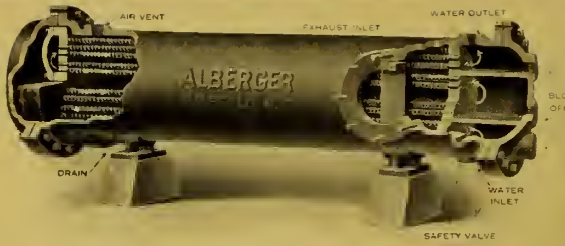
are followed in the construction of the

ALBERGER MULTI-HEAD WATER HEATERS

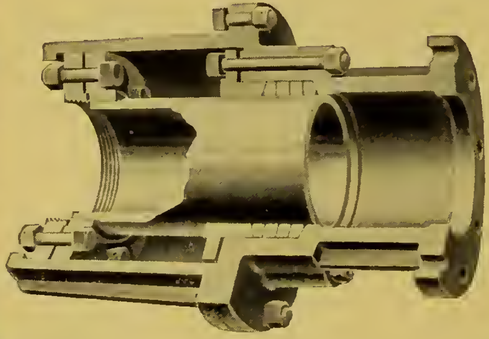
Horizontal or Vertical

Proper provision is made for expansion and contraction of the tubes and shell. Built of the highest grade materials, consisting of pure copper and cast-iron.

THE ALBERGER HEATER COMPANY
BUFFALO, N.Y.



For boiler feed water, gravity and forced circulation heating systems, hot water service for domestic purposes, etc. Special Heaters, Coolers, and Condensers built to meet unusual conditions. Catalog on request.



Howard Guided Expansion Joints

For Hot Water and Steam Pipe Lines consists of the well-known slip joint, with the improvement of a removable guide. This guide eliminates the strain that might be placed on the joint due to sagging of the pipe line, and thereby removes the only objection there has been to the slip joint type of expansion joint.

HOWARD IRON WORKS, BUFFALO, N.Y.

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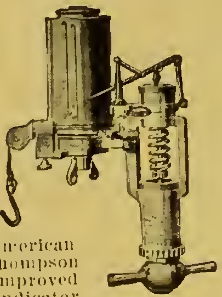

American Thompson Improved Indicator

American Power Plant Specialties

Uniformly accurate satisfactory service is assured the user of these well-known Power Plant Instruments which have been on the market for sixty-five years. Tell us your needs.

American Recording Gauge

AMERICAN STEAM GAUGE & VALVE MFG. COMPANY
BOSTON, MASS., U.S.A.

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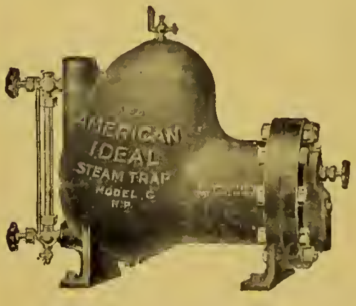
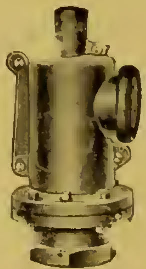


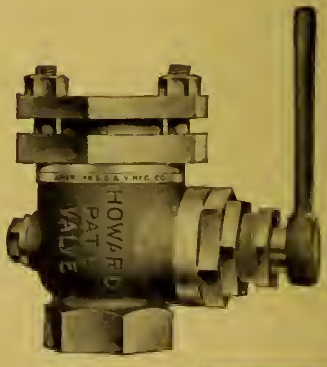
American Ideal Steam Trap

Brass Pop Valve



Iron Pop Valve

Whistle



Howard Improved Ball Valve

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

This Valve Protects Life and Property

The Foster Automatic Non-Return Stop Valve

FOSTER Non-Return Valves have been tried and tested in plant after plant—thousands are now in use—and never been found wanting.

It is the Pioneer—the original—you can absolutely depend on it to safeguard life and property in case any boiler should fall down on the job.

It doesn't stick, or chatter, or disappoint. When an accident happens to a boiler it closes instantly and cuts the disabled boiler out of the battery.

It is **reliable** because it's made in the Foster way, which means that design, material and workmanship are right in every way. Don't experiment when it comes to safety valves—buy Foster valves and you'll secure valves that **work when they're supposed to work**—they're guaranteed.

Get in touch with us, or our Canadian agents, if your boilers are not properly protected. Do it now—don't wait until to-morrow.

FOSTER ENGINEERING CO.
NEWARK, N.J., U.S.A.

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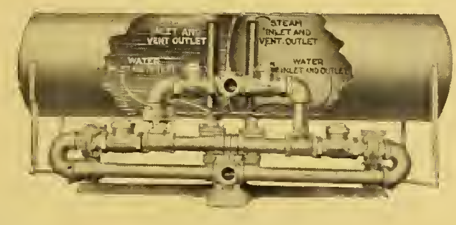

Farnsworth Tilt Traps

Contain features not found in other traps:
Double Water Seal.
Elimination of all weights, lever, frames or packed trunnion stuffing boxes.
Tilts on knife edges.
Connections made by Flexible Metal Hose.
Four styles—Lifting Traps, Vacuum Traps, Boiler Feeders. Non-Return Separating, Lifting or Pumping and Direct Return traps.

FARNSWORTH MFG. CO.
Boston, Mass.

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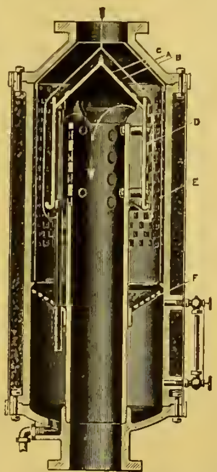
CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

SWEET'S SEPARATORS

Important things to consider about a Separator



I. THE PLAN—Is it sensible, will it work, no matter how large the separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

DIRECT SEPARATOR COMPANY
820 Geddes Street SYRACUSE, N.Y.

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Saskatoon, Calgary,
Vancouver, Victoria

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

If any advertisement interests you, tear it out now and place with letters to be answered.

"PENFLEX"
METAL HOSE
INTERLOCKING

For Steam or Air Drill, Pneumatic Tools, Boiler Flue, Cleaning Syphon Connections, Suction Lines

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities. Large stocks carried in Canada.

Pennsylvania Flexible Metallic Tubing Co.

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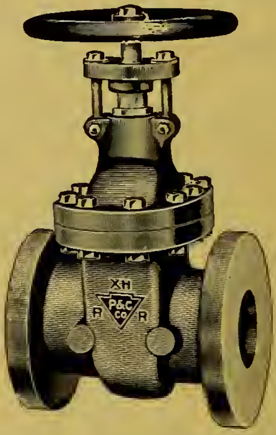

PRATT & CADY VALVES

wherever they are used; are always selected because of their durability and strength. For the past forty years the most progressive engineers in this country have conceded their superiority. They are made for every service and in many patterns and weights. Ask for our 1915 catalog.

Pratt & Cady Co., Hartford, Conn.

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CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Use DURABLA Packing

Note the Durabla Trade-Mark all over the Sheet. Look for the brand.

The DURABLA Trade-Mark is a guarantee of Quality. Gaskets cut from the DURABLA Sheet are guaranteed to make tight joints.

DURABLA MANUFACTURING COMPANY, NEW YORK, N.Y.

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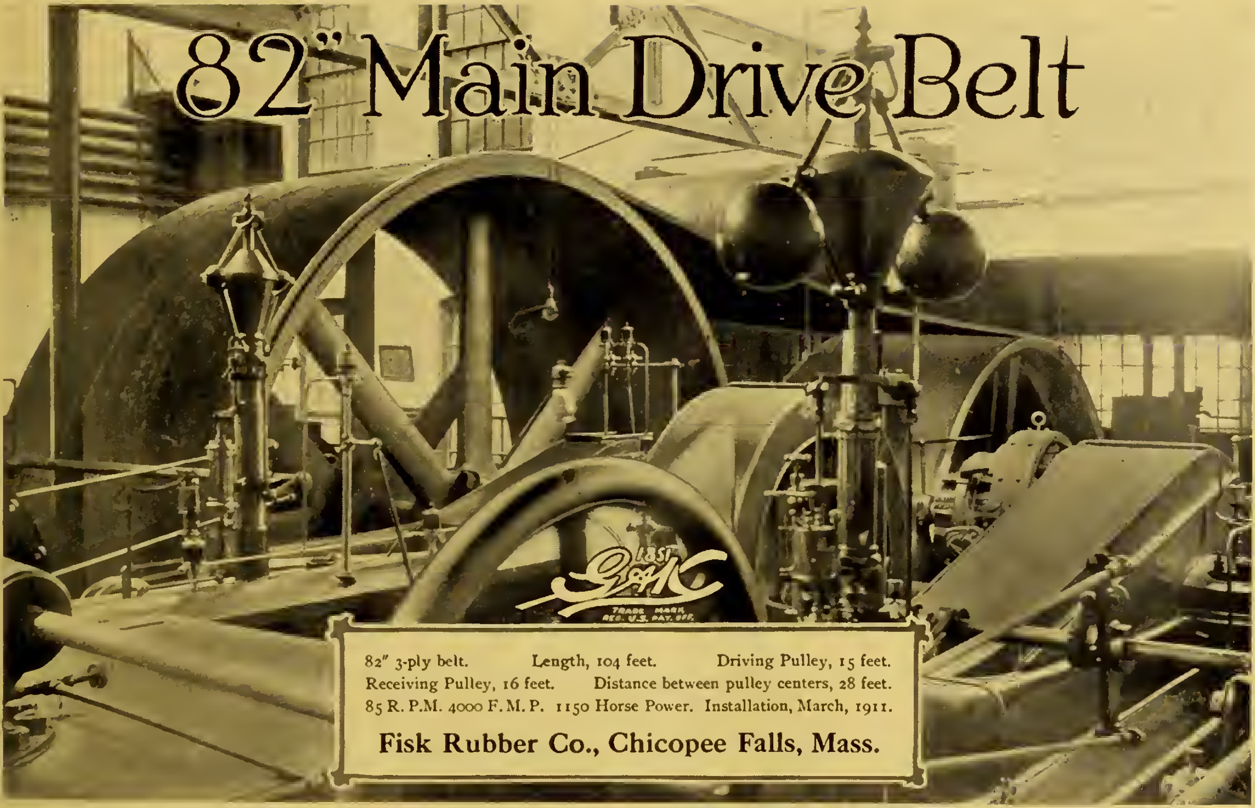

82" 3-ply belt. Length, 104 feet. Driving Pulley, 15 feet.
Receiving Pulley, 16 feet. Distance between pulley centers, 28 feet.
85 R.P.M. 4000 F.M.P. 1150 Horse Power. Installation, March, 1911.

Fisk Rubber Co., Chicopee Falls, Mass.

One Inch or Eighty-two Inch

Lathe Belt or Main Drive Belt. For any service and every service, G & K Belts give absolute satisfaction

Because like the Fisk 82", all G & K Belts from the smallest to the largest are quality products throughout. They are carefully constructed from leather of our own tannage, tanned slowly, uniformly, and expressly for belting purposes. They possess the essential qualities of pliability, firmness with minimum stretch, great tensile strength, and durability. Lastly, they are absolutely guaranteed as to quality and workmanship.

There is a G & K Belt for every drive—its use means maximum production and low cost of operation.

Our Engineering Department is thoroughly equipped to give expert assistance and advice upon any transmission problem, and to investigate and design any drive upon request. Why not let us serve you?

THE GRATON & KNIGHT MFG. CO.

Oak Leather Tanners and Belt Makers

WORCESTER, MASS., U.S.A.

Branches:
Atlanta
Boston
Chicago
Cleveland
Detroit
Fall River
Kansas City
Minneapolis
New Orleans
New York
Philadelphia
Pittsburgh
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Selling Agents: Graton & Knight Manufacturing Company of Texas, Dallas, Texas.
Graton & Knight Manufacturing Company of Wisconsin, Milwaukee, Wisconsin.
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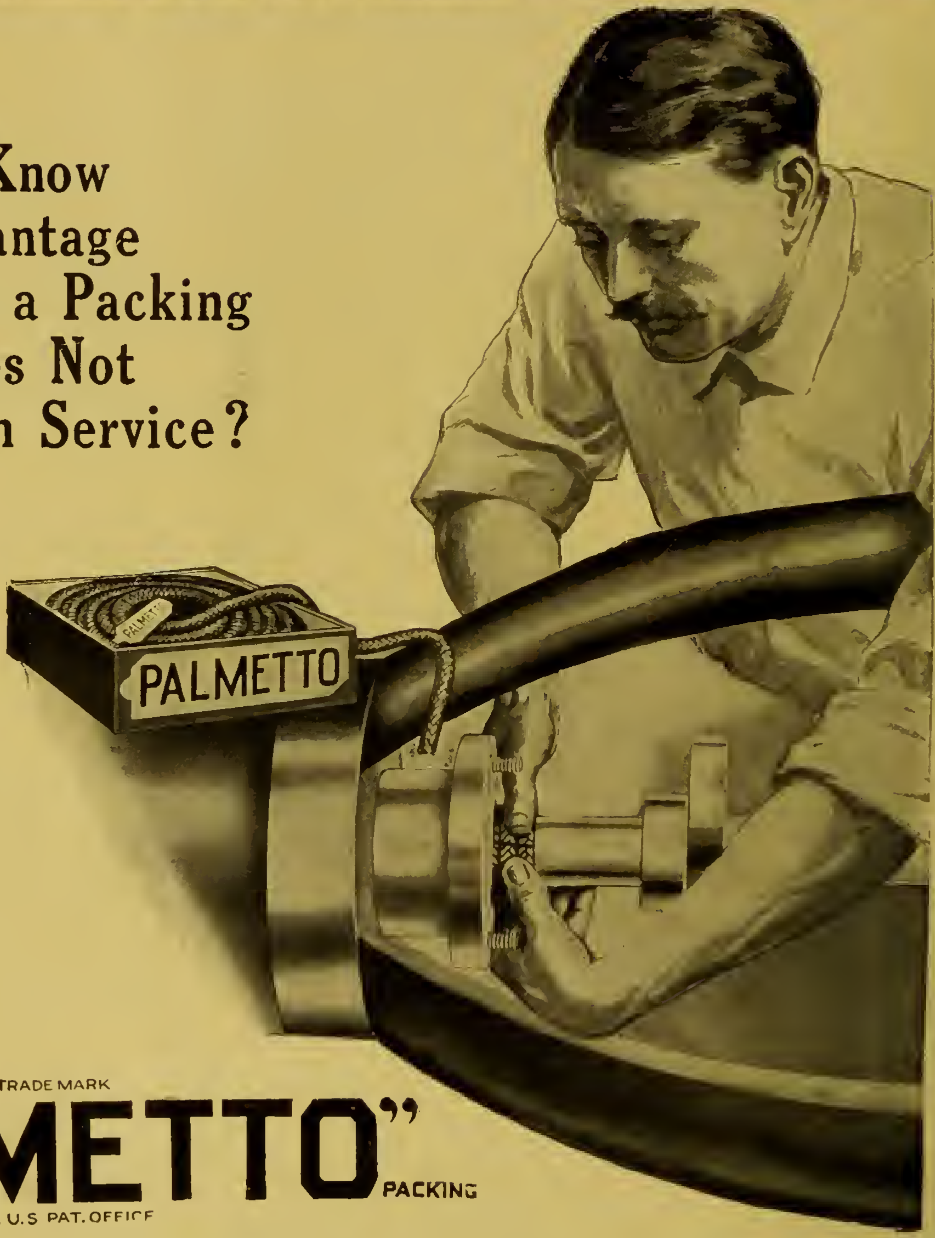
CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Do You Know The Advantage Of Using a Packing That Does Not Harden in Service?



It means long,
satisfactory service.

TRADE MARK
"PALMETTO" PACKING
REG. U.S PAT. OFFICE

is lubricated in each separate strand with a compound that keeps it soft and pliable in service and so preserves its packing qualities, which means a great saving in both labor and packing cost.

"Palmetto" is Made of Heat-Resisting Materials

and is just the Packing for up-to-date conditions.
Let us send you a free working sample in order that you may test same for yourself.

Greene, Tweed & Co., Sole Manufacturers, 109 Duane St., **New York**

SOLE CANADIAN AGENTS

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The Canadian Fairbanks-Morse Co., Limited
St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon,
Calgary, Vancouver, Victoria

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

The Absolute Simplicity of the "Detroit" System is Remarkable

Are These Cases Alike?

A bookkeeper once laid the money for the pay-envelopes near an open window. A gust of wind carried several $10 bills out of the window. They said the bookkeeper was careless, and fired him.

The engineer in charge of the company's big power plant never made any provision to return the condensation to the boilers. But nobody fired him, though hundreds of dollars' worth of heat was escaping into the air in the form of steam.

Both men were causing their employers avoidable loss. But in the latter case the employers did not recognize it. But they would have recognized the big saving that a proper steam-trap would make in their coal bill and would have rewarded the man who suggested its installation.

Are you throwing ten-dollar bills away? Are your steam-lines exhausting into the atmosphere?

A "Detroit" System will put an end to this waste of heat.

A receiver and pump will save considerable, but it will not handle condensation above a certain pressure, nor will it return the condensation directly to the boilers at the highest temperature. The "Detroit" System will return all the condensation to the boilers at a temperature just below the boiling point.

Instead of having to raise water from about 65 degrees to 212 degrees, you need only boost your condensation a very few degrees. Think of the fuel saved.

The "Detroit" System increases efficiency of steam coils or steam-heated machinery by keeping the lines free from condensation.

Investigate the "Detroit" System now. It will make a big cut in your production cost. Ask us to send you the book "Watch Your Condensation" No. A-14.

CANADIAN *Sirocco* COMPANY
LIMITED

WINDSOR, ONTARIO.

SALES OFFICES

S. S. Clarke,
605 2nd St.,
Calgary.

A. M. Nichol,
301 McGill Bldg.,
Montreal.

W. W. Hicks,
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Sales Co.,
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Phone Main 5118

Canadian Sirocco Company, Ltd.,
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KERR
ECONOMY
KERR
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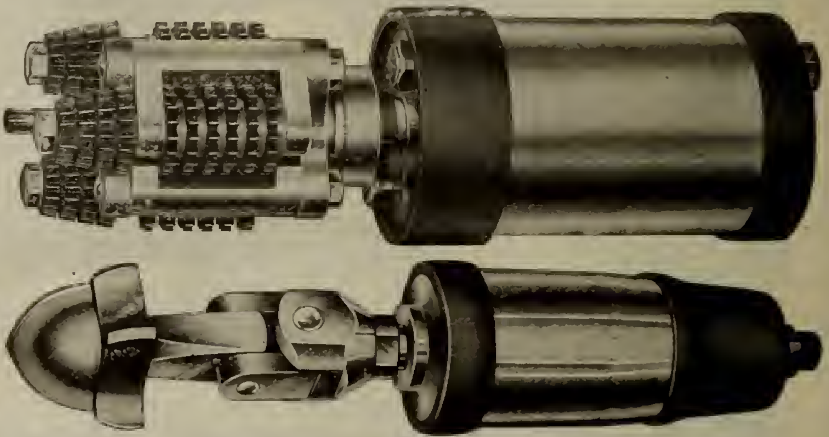

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The Vigilant Feed Water Regulator has no floats in its construction, for the best of floats, with all their guarantees, will leak and become water logged or collapse, in spite of all arguments to the contrary. Under heavy pressure the water seems to penetrate the pores of the metal. The Vigilant has no floats, no diaphragms, no complicated system of levers and small valves, no concealed or obscure steam passages.

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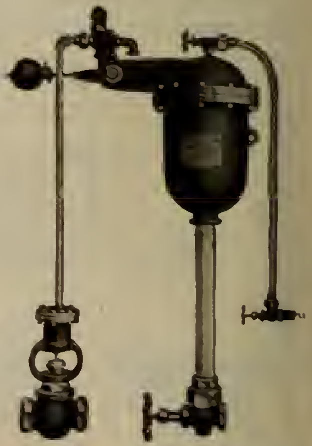

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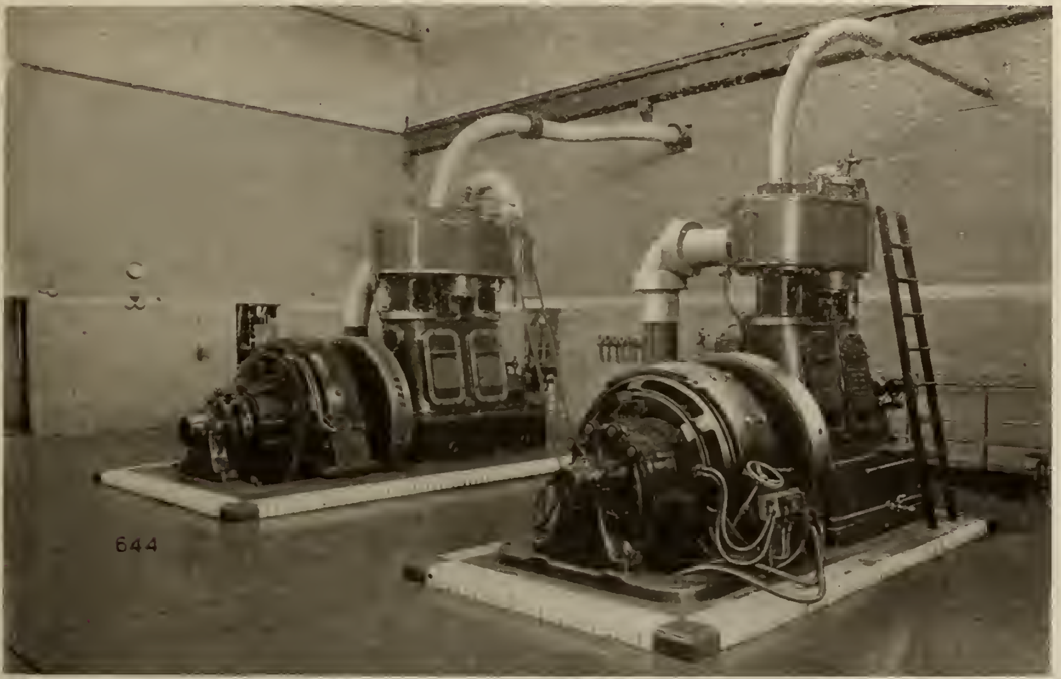

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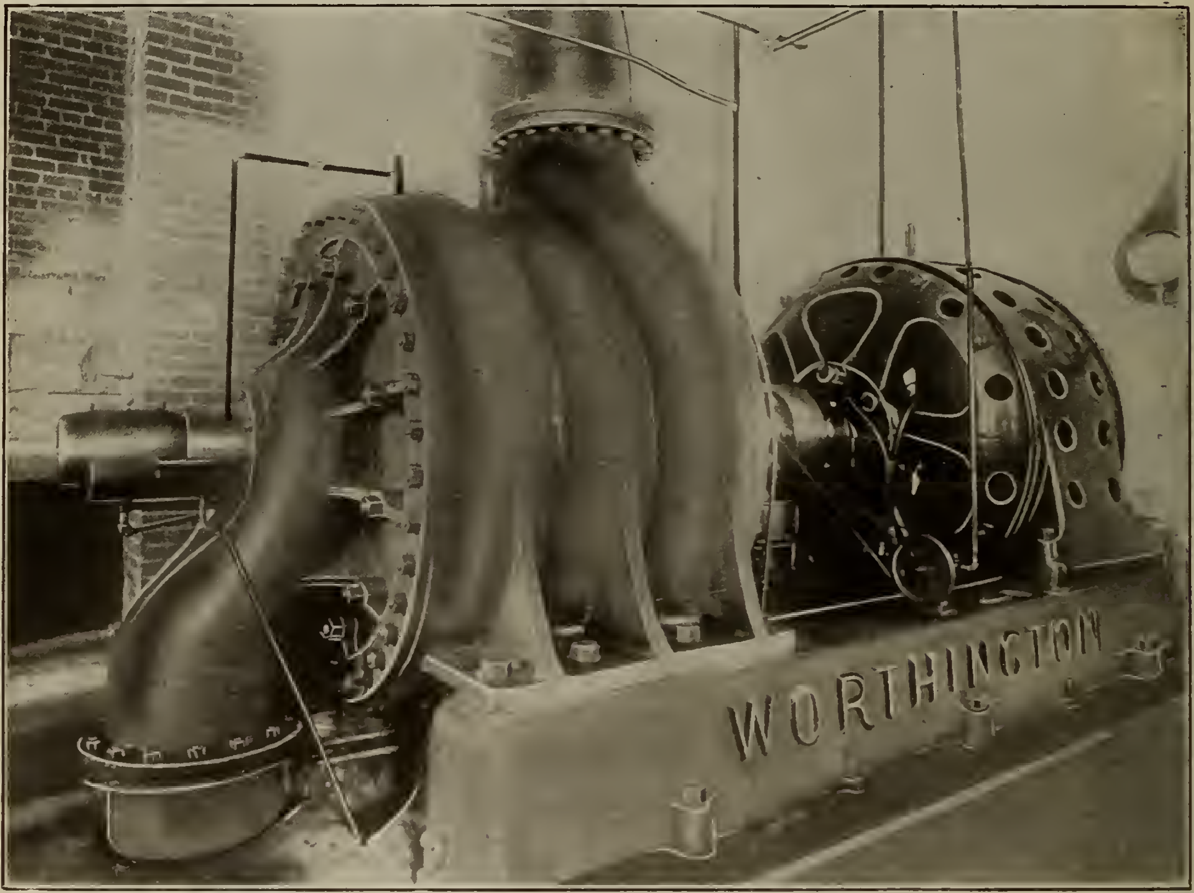

5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

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The Publisher's Page

The Convention in Montreal

UNLESS all signs fail, the C. A. S. E. convention which is to be held in Montreal during the week of July 24th, will be by far the best ever.

Preparations have been under way for months and no stone has been left unturned in clearing the way for a big success.

The Exhibitors' Association has been particularly busy, and an unusually attractive and interesting exhibition of power plant equipment, specialties, etc., has been arranged.

> Mr. H. L. Peiler, President C. A. S. E. Exhibitors' Association, in a recent letter to The Power House, said:
>
> "The plans for the Power Show exceed anything of the kind that has ever before been attempted in Canada. Out of fifty-six available spaces forty-eight have already been taken, and practically every important manufacturer of power plant specialties will be represented either directly or through their agents."

We are satisfied that as many of our readers as can get away from their work for a few days, and can do so conveniently, will attend the Convention and visit the Power Show. They will have a good time, meet scores of their fellow engineers, and enjoy the opportunity to inspect many of the things they have seen advertised in The Power House.

Advertising, as so many of our subscribers realize, is but another way of exhibiting meritorious products, with this difference, that advertising goes to the people while the people have to go in person to an exhibition.

The advertising section of each issue of The Power House constitutes a veritable power show in itself, and it appears simultaneously in all parts of Canada.

The avowed purpose of the C. A. S. E. is to "promote education, professional and mechanical knowledge." Once a year, your delegates meet and embrace the opportunity of examining and studying at close range the exhibits provided by the manufacturers and dealers. This privilege is of necessity confined to a comparatively limited number each year. The benefits to be derived from a study of The Power House advertising "exhibition" are not restricted, but are open to every studious, ambitious engineer in Canada.

THE POWER HOUSE
143-153 University Avenue, Toronto, Canada
Montreal Winnipeg London, England Boston New York Cleveland Chicago

Power Equipment

Steam Engines and Turbines, Return Tubular and Water Tube Boilers, Heaters, Pumps and Condensers

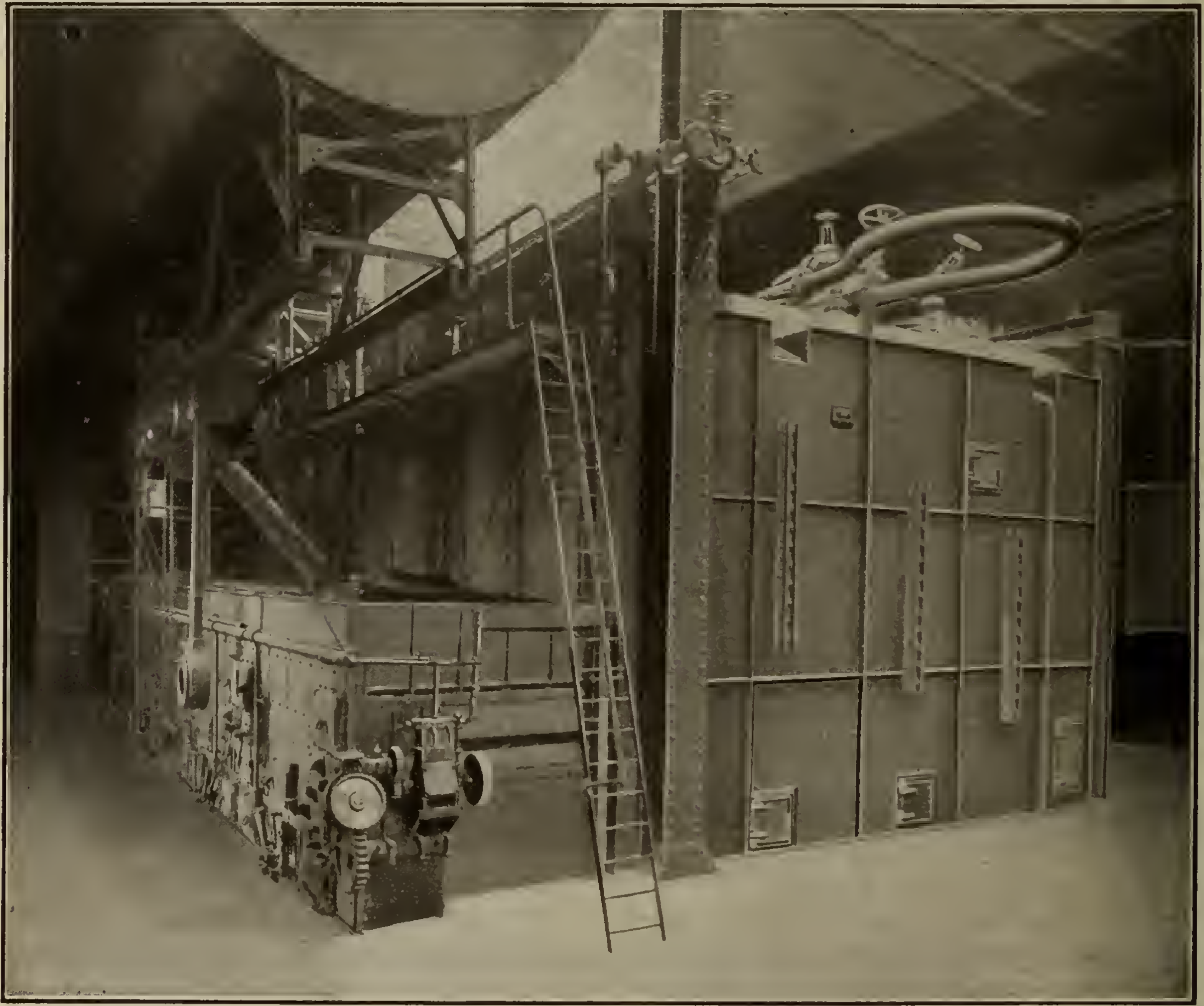

Illustration shows the Boiler Room at the New Asylum for the Insane, Whitby, Ont. equipped with 4 G. & McC. Co. Sectional Water Tube Boilers.

The Construction of G. & McC. Co. Water Tube Boilers meets the demand for higher quality. EVERY PART SUBJECTED TO STEAM PRESSURE IS MADE OF FORGED STEEL. They excel in positive and rapid circulation and in increased Steaming Capacity. Ask for our catalogue and more detailed information if interested.

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AN EXTERIOR IMPRESSION OF MONTREAL'S TECHNICAL SCHOOL.

The Montreal Technical School, Its Equipment and Service

Staff Article

In the brief space of some five years since establishment, the Montreal Technical School has amply demonstrated its worth as a developer of our national, commercial and industrial enterprise. A recital of the contributory factors which have influenced its achievement in these respects should, in consequence, be at once interesting and instructive, besides lending impetus to the movement for further installation of similar institutions within our borders.

IN the early days of modern engineering the opportunities of acquiring a knowledge of the principles of various branches, either from a practical or theoretical standpoint, were very limited, in comparison with those of the present time. The remark is often heard that "there are fewer possibilities for advancement now than years ago." This in many respects is a mistake, for while the achievements of the scientific world in the past quarter of a century have been exceedingly remarkable, the probabilities are that the next twenty-five years will surpass all previous records; and it is the boys and young men of today that we must look to for the accomplishment of these future developments in all branches of science and engineering research.

Before the advent of systematic training, the average boy was generally taken into a workshop without any previous knowledge of the duties he would have to perform; and his success, or failure, resulted largely in his ability to adapt himself to his new environment, aided possibly by the advice and instruction of one or two of his shop mates and occasionally the foreman.

The ideal system of training for engineering trades is by means of technical schools. Through these institutions, all classes of boys are given adequate and complete instruction in the various trades, both from a theoretical and practical standpoint, and the Montreal Technical School described in this article is a recent example of the perfection to which educational institutions of this nature have been developed.

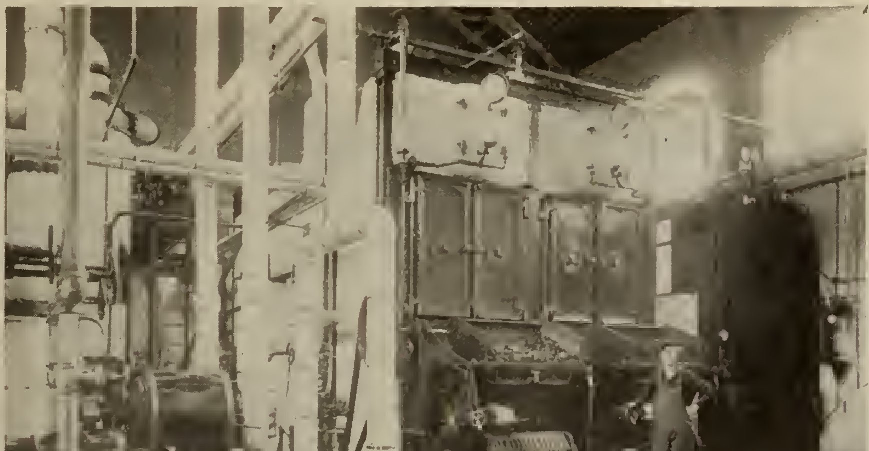


FIG. 1. SHOWING PUMPING AND BOILER INSTALLATION.

Main Building

This large commodious building, built and equipped at an approximate cost of $825,000, and annually subsidized by the Provincial Government of Quebec, with an additional yearly grant from the City of Montreal, was officially opened in 1911. The building is composed of two distinct sections, the main structure, which con-

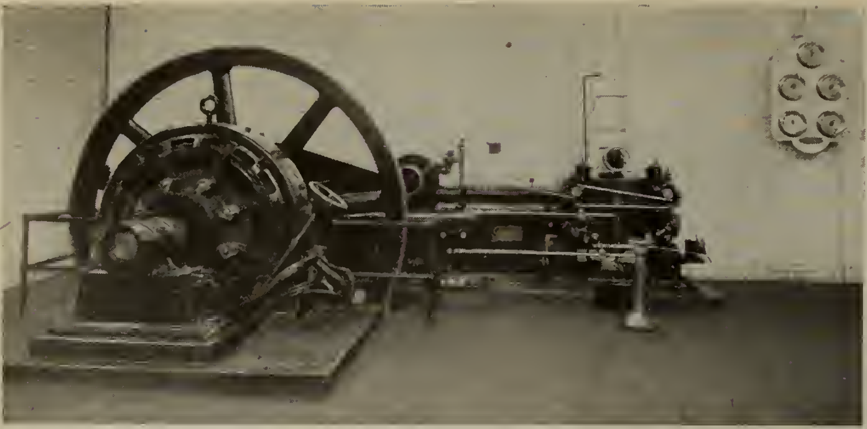


FIG. 2. CORLISS ENGINE AND GENERATOR OF 150 H.P. AND 125 K.W. RESPECTIVELY.

tains the administration offices, being located on Sherbrooke Street. In addition, there are several suites of class rooms for theoretical teaching, the various laboratories, two small amphitheatres to seat 100 each, one large amphitheatre with a seating capacity of 600, and a large hall.

In addition to requirements for instruction, the comfort of students is well provided for:—spacious and convenient waiting rooms, toilets, shower baths, and suitable furniture being installed; in fact, nothing has been spared to provide modern and efficient surroundings conducive to the success of the school as an educational institution, while from the viewpoint of comfort and hygiene, conditions approach the ideal.

Boiler Room

To the rear of the main structure are the power house and various work shops, all constructed along the lines of modern industrial practice. The power house, which is in the middle of the group consists of a boiler room, an engine room and a gas producer plant. The boiler room equipment shown in Fig. 1, consists of two Babcock & Wilcox 200 horsepower, water tube boilers, equipped with chain grates, operated by a Miller Bros. and Jones vertical engine; one Delaunay Belleville (French) marine type 100 h.p., hand fired boiler, with automatic regulated water feed. Two plunger type, Fairbanks-Morse pumps are used for the feed water, these are shown in the left foreground of Fig. 1. To the rear of the feed water pumps are two Kerr steam turbines, direct connected to two 24-inch centrifugal pumps, for supplying water to the forced hot water heating system, throughout the buildings. Two large Cochrane heaters are also installed, so arranged that one is supplied with exhaust steam from the

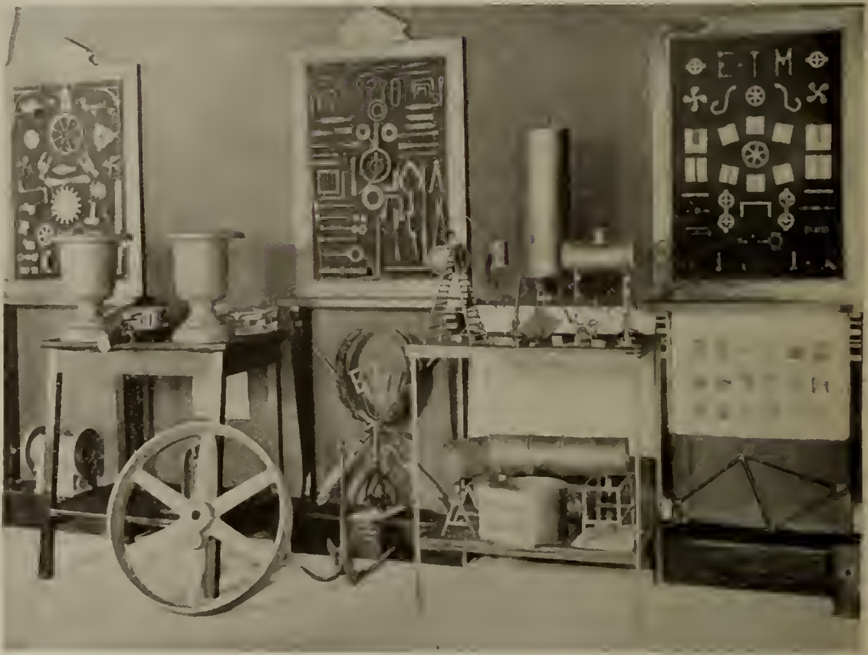


FIG. 4. PRODUCTS OF THE SCHOOL FOUNDRY, FORGE, AUTOGENOUS WELDING AND MACHINE SHOPS, ETC.

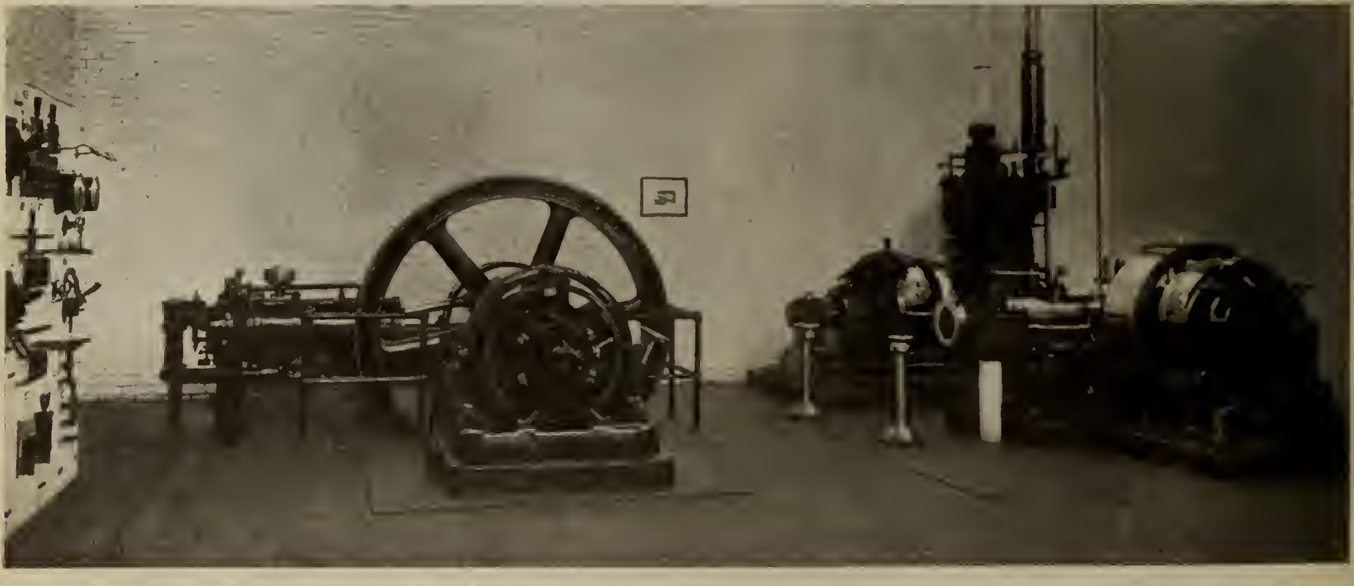


FIG. 3. SHOWING 35 H.P. HORIZONTAL GAS ENGINE, 35 H.P. HORIZONTAL STEAM ENGINE, AND COMPOUND VERTICAL STEAM ENGINE, DIRECT CONNECTED IN EACH CASE TO GENERATORS.

engines and the other with live steam from the boilers. In the event of insufficient exhaust steam being available to heat the water to the desired temperature, an automatic system of control operates a valve and allows the water to pass through the live steam heater before passing to the heating apparatus throughout the building.

Heating and Ventilating System

An interesting feature of this installation is the utilization of every pound of exhaust steam for heating purposes before the addition of live steam becomes necessary and the consequent absence of back pressure on the engines. This system is so satisfactory that the return water after heating is only a few degrees below that of the outgoing or heated water. The large ventilating fans and steam coils are regulated by the Powers system of automatic temperature control.

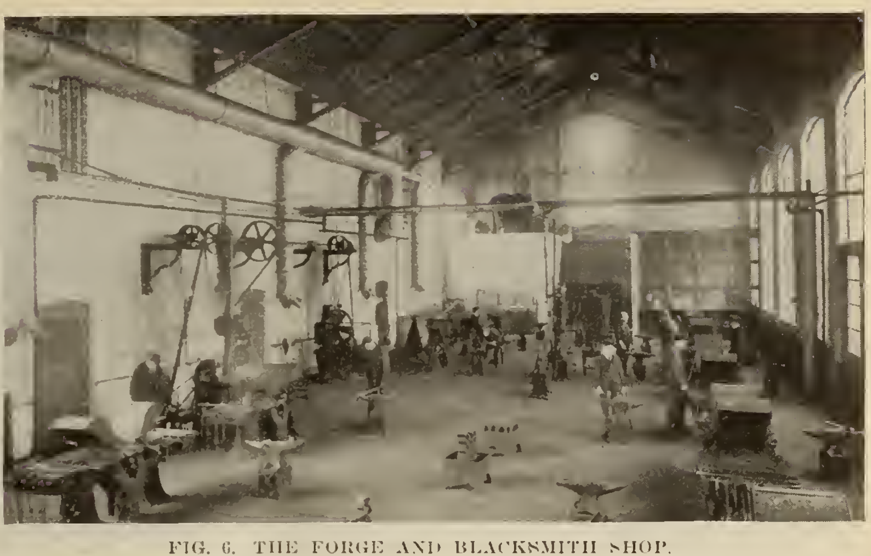


FIG. 6. THE FORGE AND BLACKSMITH SHOP.

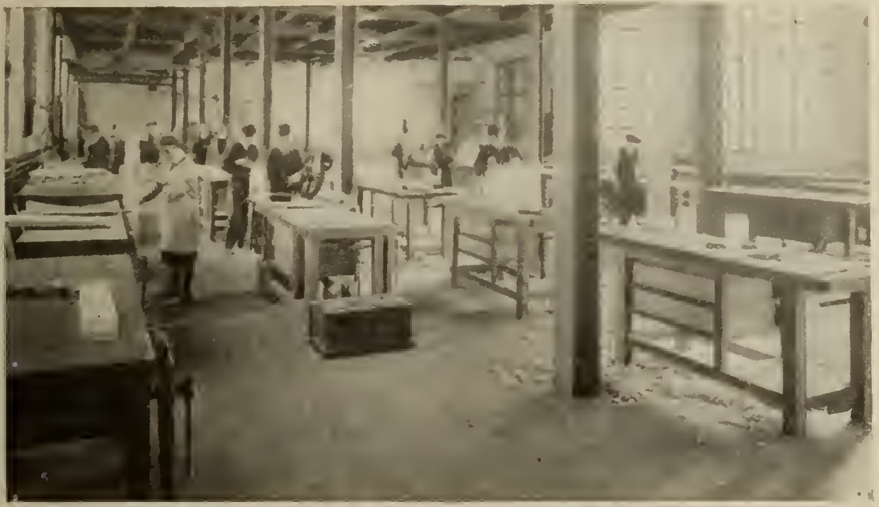


FIG. 5. CARPENTER, JOINER AND PATTERN SHOP.

An allowance of 30 cubic feet of fresh air per minute is provided for each pupil with a liberal additional amount of ventilation in all class rooms and workshops.

A complete vacuum cleaning system is installed, with connections at convenient location throughout the entire building.

Engine Room

In keeping with the general policy of instruction and at the same time to provide the necessary power equipment for the building the engine room units are of various, but modern types. The largest unit is that shown in Fig. 2, which is a 150 horse-power Goldie & McCulloch Corliss engine, direct connected to a 125 k.w. Allis-Chalmers-Bullock generator. The other three units are shown in Fig. 3. In the right background is shown the 100 horse-power vertical compound, Belliss and Morcom engine, equipped with forced lubrication system, and direct connected to 75 k.w. Westinghouse generator. Directly in front of this is seen the Robb-Armstrong 35 horse-power horizontal engine, direct connected to a 35 k.w. Canadian Crocker-Wheeler generator. To the left is shown a Duplex (French) 35 horse-power gas engine direct connected to a 25 k.w. Canadian General Electric generator. This unit is operated with producer gas, obtained from a small plant in the adjoining room. This consists of a Pierson (French), gas producer, with scrubbing and cooling equipment which delivers clean gas at a suitable temperature for use in the engine. A suction fan operated by a Robbins & Myers motor is used to start the gas producer. To operate the Duplex engine it is necessary to start with compressed air, which is supplied to a reservoir at a pressure of 175 lbs. per sq. inch. After the first stroke the gas is drawn into the engine and automatically regulated acording to the load.

In addition to the gas producer this room contains an Ingersoll-Rand air compressor for supplying high pressure air for pneumatic tools, etc.

It might be stated here that practical lessons on the construction and operation of gas and steam engines are given to engineering students by their class

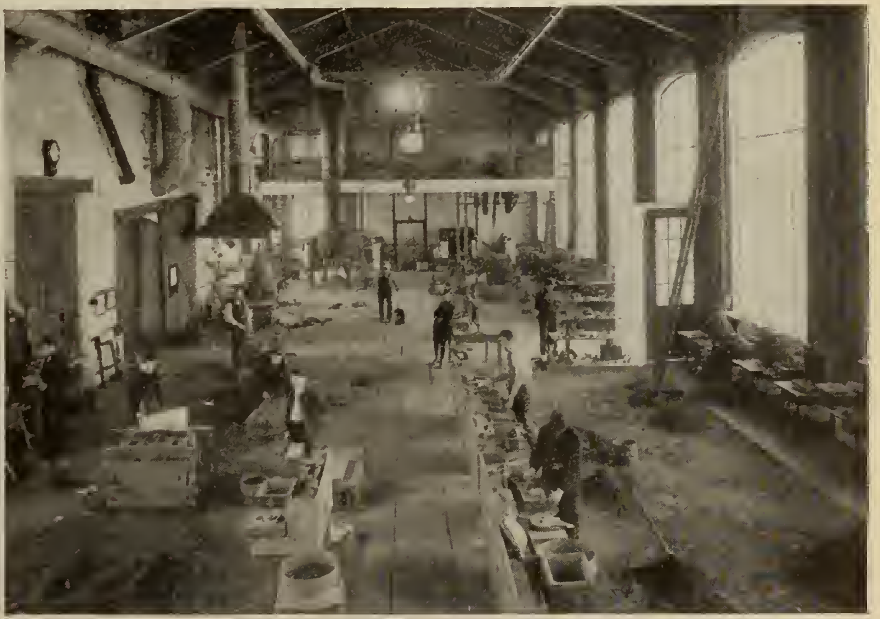


FIG. 7. THE GREY IRON FOUNDRY.

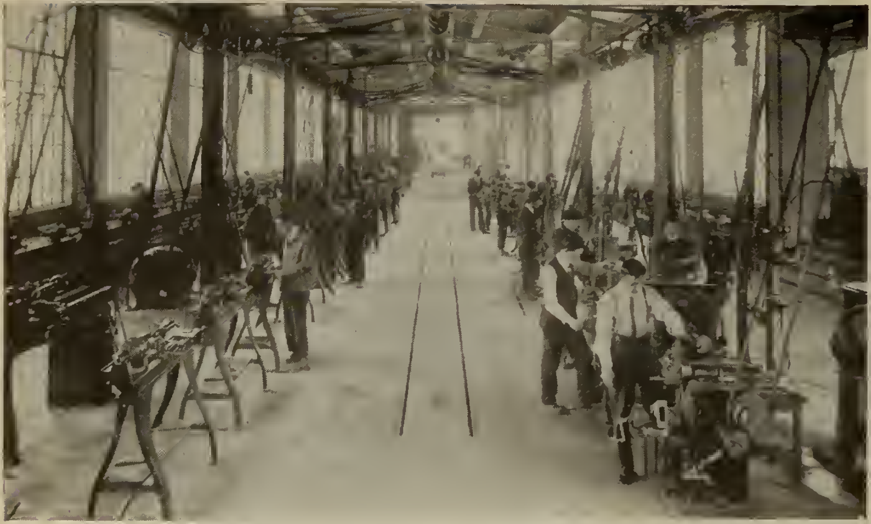


FIG. 9. VIEW IN MACHINE SHOP.

instructors, aided by the engineer of the power house; in addition to which there are numerous models, in section, of feed water pumps, injectors, and many engine room accessories from which the pupils are given personal instruction.

Main Switch Board

The engine room switch board consists of seven panels of polished white Italian marble. The feeder panels from which radiate the various primary circuits contain a Bristol watt-hour meter for recording total station output, and three double pole plain overload circuit breakers. Knife switches, with enclosed fuses on the face of the board, control the lighting feeders. The accumulator panel is equipped with meters, overload breaker, a battery rheostat and an eleven point end cell switch. The generator panels are fitted with Weston flush-type ammeters, with a range of 150 per cent. of generator output; and three-pole knife switches with fuses on the rear of the board.

A voltmeter, located at the extreme left of the main switch board, and supported on a swinging arm, can be made to indicate either the bus bar voltage, the voltage of any machine, or the drop of potential between the bus bars and the ground.

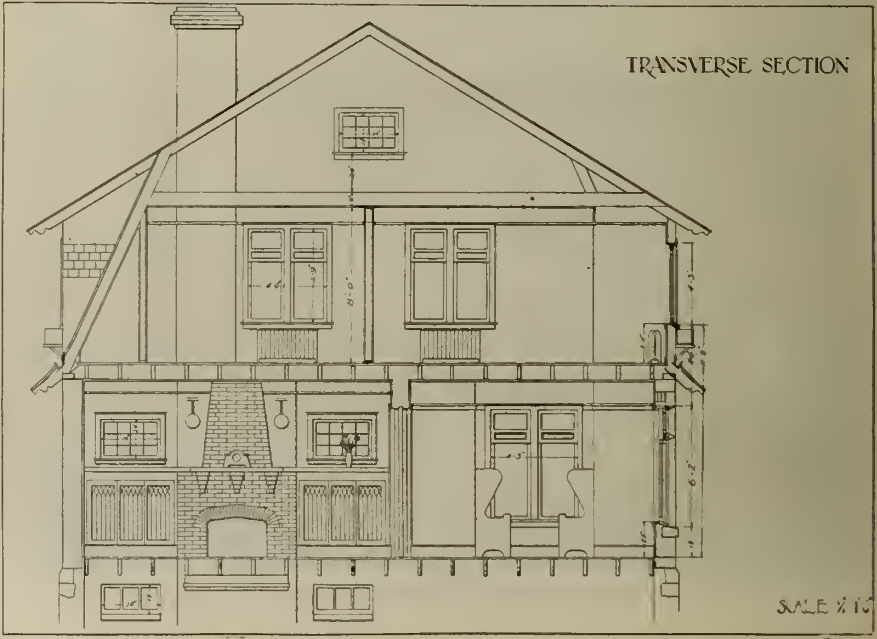


FIG. 10. SUBURBAN HOUSE—WORK OF A THIRD YEAR STUDENT.

Wood Working Shop

A fully equipped wood working department, with an area of 6,810 square feet supplies ample facilities for thorough instruction in carpentry, joinery and pattern-making. The machine equipment comprises eight power wood-turning lathes, four motor driven lathes of variable speed, one each, band saw, circular saw, jig saw, buzz planer, pony planer, mortising machine, tenoning machine, drill, shaper, trimmer, automatic band saw filing and setting machine, band brazer, and two grindstones; 30 benches, part of which are shown in Fig. 5, are also provided each with two separate sets of tools, one for the day and the other for the night classes.

Foundry

This department has a total area of 5,210 square feet and all the castings used in the various workshops are made here by the pupils, with the aid of the instructor. The equipment consists of a 2-ton per hour King cupola, one oil melting furnace, underground installation of compressed air for operating elevator and pneumatic tools and machines, two moulding presses, two core ovens, one core machine, one coning machine, one sand sifter, one sand mill, two snagging wheels, one torch heater and moulding benches for 24 pupils. Two 1-ton traveling chain blocks are used for transferring castings and material.

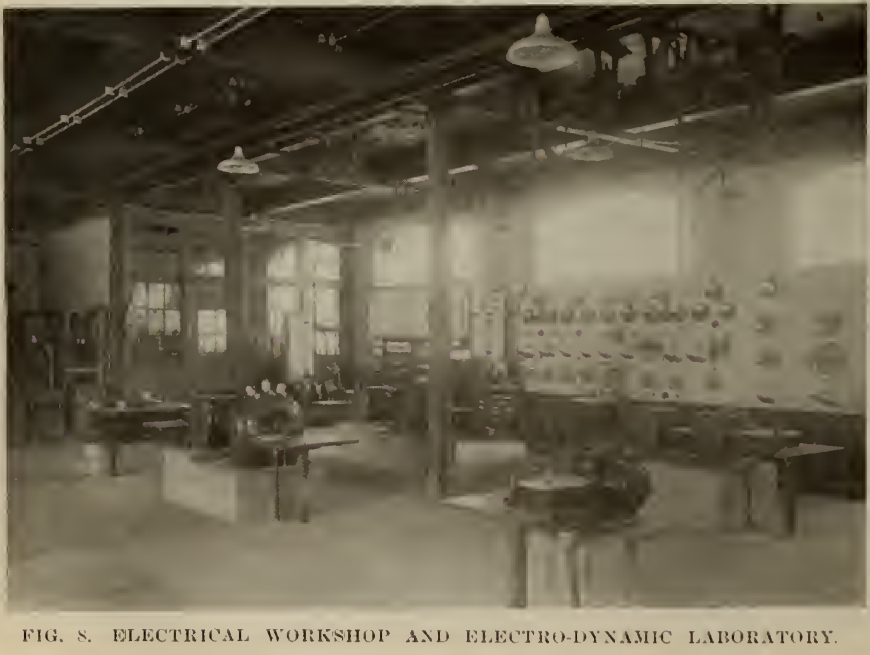


FIG. 8. ELECTRICAL WORKSHOP AND ELECTRO-DYNAMIC LABORATORY.

Forge Department

This section has a total floor space of 5,210 square feet and contains 24 Sturtevant forges, operated by forced blast supplied through underground piping from a 24-inch fan direct connected to a Sturtevant Co. four horse-power motor. A large 4-foot fan operated by a 9-horse-power electric motor is used to draw the smoke and gases from the fires and exhaust the same through the roof. This equipment is shown in the top background of Fig. 6. An anvil is supplied with each forge, and in addition there is one case hardening and tempering furnace, 30 inches square, supplied by the Buffalo Forge Co., one 170 lbs. steam hammer, made by Vulcan Iron Works, one Plessisville Foundry 75 lbs. spring hammer, one McGregor Gourlay Co. shear, also two swage blocks, two blacksmiths' vises, one tool bench and vise, and a plentiful supply of tools for each fire.

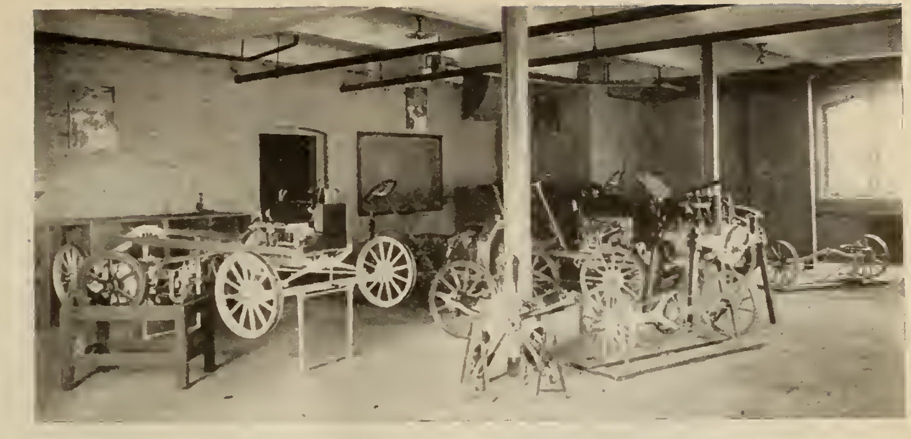


FIG. 12. AUTOMOBILE CHASSIS CONSTRUCTION AND ASSEMBLY.

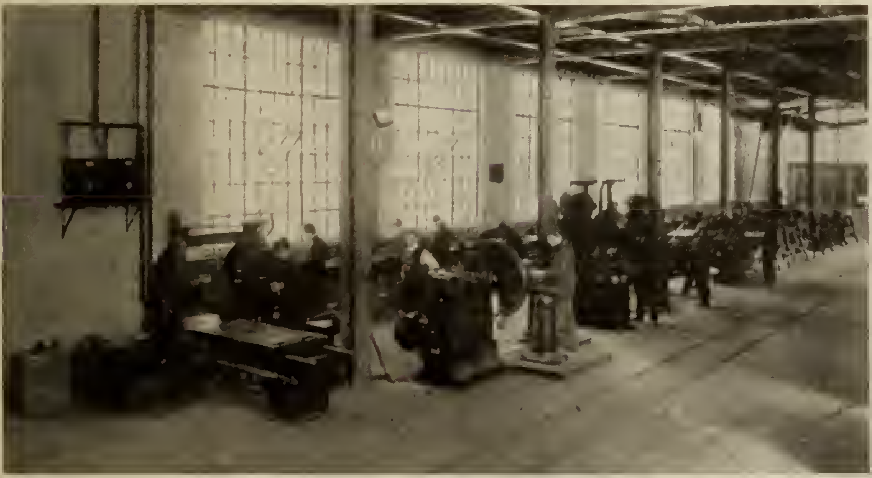


FIG. 11. ANOTHER VIEW IN MACHINE SHOP.

Electrical Section

Directly adjoining the machine shop is the electrical workshop and the electro-dynamic laboratory; the former containing one armature banding and heading machine, one notching press, one shear, one pair smoothing rolls and one buffer. In the laboratory are five groups of induction motors, one single-phase synchronous motor coupled to a direct current dynamo; one direct current motor coupled to a three-phase generator; one compound wound generator, one six-change commutator and one direct current motor coupled to an alternator. A large seven-panel switch board, fully equipped for experimental and operating purposes is also provided. There is also a switch board for telephone instruction, and a storage battery having a capacity of 200 ampere-hours.

Machine Shop

The large and modern machine shop, with a total floor area of 11,340 square feet, offers excellent facilities for thorough and efficient instruction in machine shop and tool room work. As shown in Fig. 9, the shop is of extensive proportions, well lighted and equipped with a large number and variety of modern types of machines. All instructors have had many years of practical experience and are well qualified for their respective positions.

The machine tool equipment is divided into three sections, each section being driven by a 15-horse-power Crocker-Wheeler motor. The machines installed are:

Drills.—One American Tool Works, 3-ft. radial; two 20-in. Rockford; two 16-in. W. F. & J. Barnes; two 16 in. Hoefer; four 12-in. Rego; one 10-in. Freeport; two 10-in. Hamilton Machine Tool Co.; one Washburn drill grinder.

Shapers.—Three 12 in. F. Pratt & Co.; one 16-in. R. A. Kelly.

Planers.—One 2 x 2 x 5 ft., and one $2\frac{1}{2}$ x $2\frac{1}{2}$ x 7 ft R. Gardener & Sons, Montreal.

Lathes.—Ten 10-in. Seneca Falls speed lathes; two 12-in. Seneca Falls; four Jones & Burton 10-in. gap; one Flather 15-in.; one Springfield 15-in. motor driven; three Fay & Scott 16-in. motor driven; one C. M. C. 18-in.; one Reed 18 in.; one Seneca Falls 14 in.; one Cisco 16 in.; one Von Wyck 18 in.; one Hendey 16-in. special lathe; and one Hare 6-ft. face plate lathe.

Milling machines.—One Brown and Sharpe universal; one Jones & Burton horizontal; one Becker vertical; and one Greenwood & Batley vertical.

Miscellaneous.—Two Whitton centreing machines; two Greenerd arbor presses; one Becker automatic gear cutter; one Binsse horizontal boring machine; two screw-cutting machines; one Hartford automatic screw machine; one 7-in. slotting machine; one pantograph; one Columbia winding machine; one set 4 x 30 in. Brown Boggs forming rolls; one Max Ames power press; one profiling machine; one 36-in. Brown Boggs

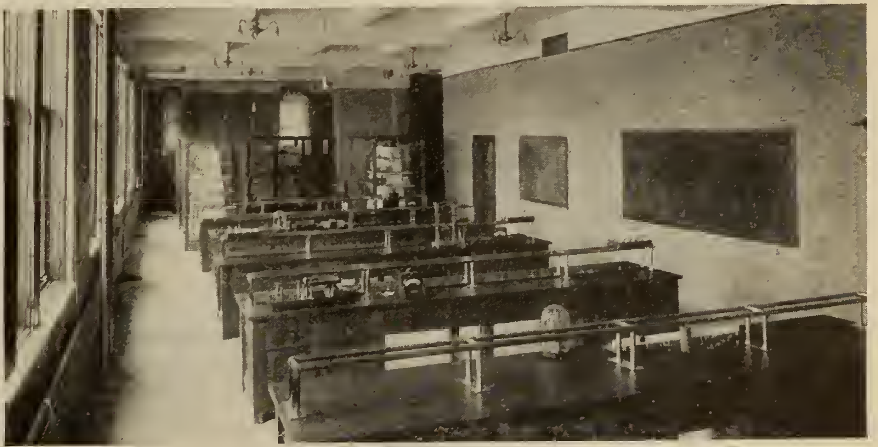


FIG. 13. PHYSICAL LABORATORY.

shear; one Norton universal grinder; two Montreal Technical School hack saws; two J. G. Blount grind stones and two 12-in. emery wheels.

In a separate room are two Stewart furnaces for hardening and tempering tools and dies.

Oxy-Acetylene Welding

So as to keep pace with the progress being made in the use of the blow pipe for cutting and welding purposes, the authorities of the school, at the opening of season of 1914-15, started a night class on the uses and operation of the oxy-acetylene method of autogenous cutting and welding. This latest branch of technical education has met with very encouraging success. Some of the results of the first year's work are shown on the right hand table and wall panel illustrated in Fig. 4. This department is under the direct supervision of the "L'Air Liquide" Society.

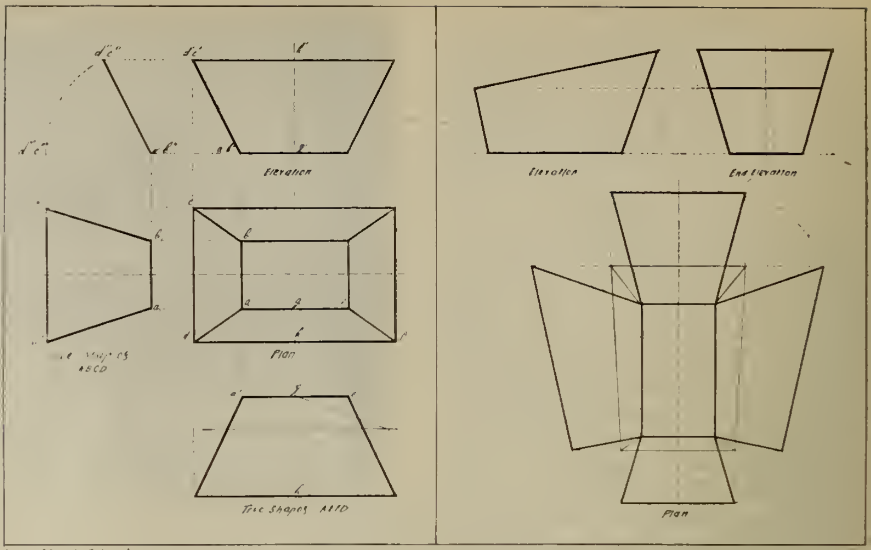


FIG. 15. RABATMENTS—WORK OF A FIRST YEAR STUDENT.

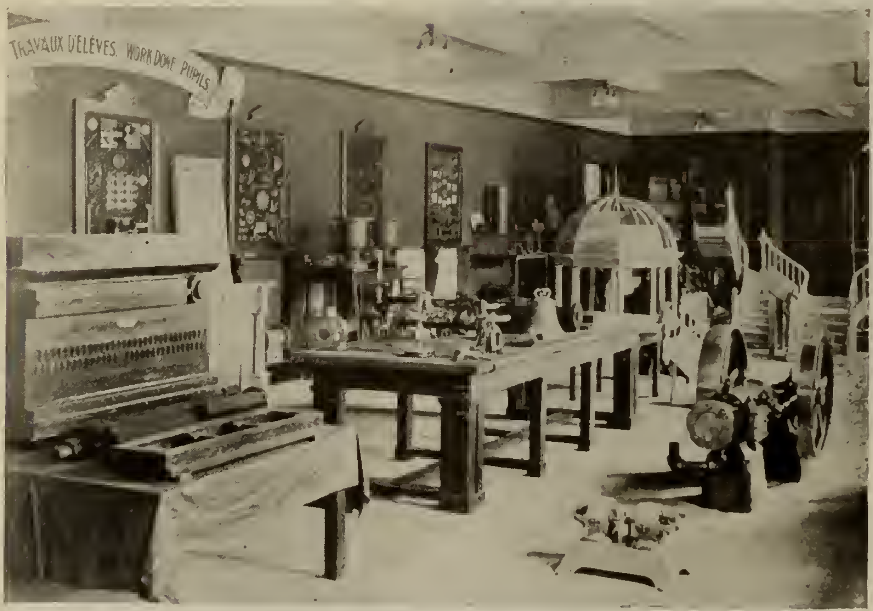


FIG. 14. EXHIBIT OF STUDENTS' WORK.

Industrial Drawing

In keeping with the high standard maintained by all the other branches, that of mechanical and architectural drawing has yielded very encouraging results. The boys receive instruction from the simplest form of free hand sketching, on through the various sections of elementary geometry, projection and development of surfaces, sketching from models and machines and assembling the same from the free hand sketches previously taken. That the work is of the best, can be shown by referring to the line reproductions here shown of the work of some of the students, whose ages average around 16 years. The work showing the transverse section of a dwelling and the details of the Roman Corinthian were accomplished by a boy seventeen years of age.

During the third year, pupils are permitted if they so desire to make detail sketches of operating machines in the shop and assemble the same as shown in the line cut of the slotting machine.

Rules and Duration of Classes

This school offers day courses for regular students, from September to June, and night courses from October to March; the latter intended primarily for workmen and apprentices engaged during the day in the various manufacturing and building trades. As the school is not self-supporting a reasonable fee is charged for both the day and night classes; but in the case of boys wishing to take up a day course and not in a position to finance the same, provision is made whereby it is possible for almost any young man to receive the required tuition, at practically little or no expense.

The day courses are organized principally for the benefit of young men, who, having recently finished their primary or elementary studies, are anxious to acquire manual proficiency and the technical education necessary to become skilled mechanics, capable foremen or shop superintendents.

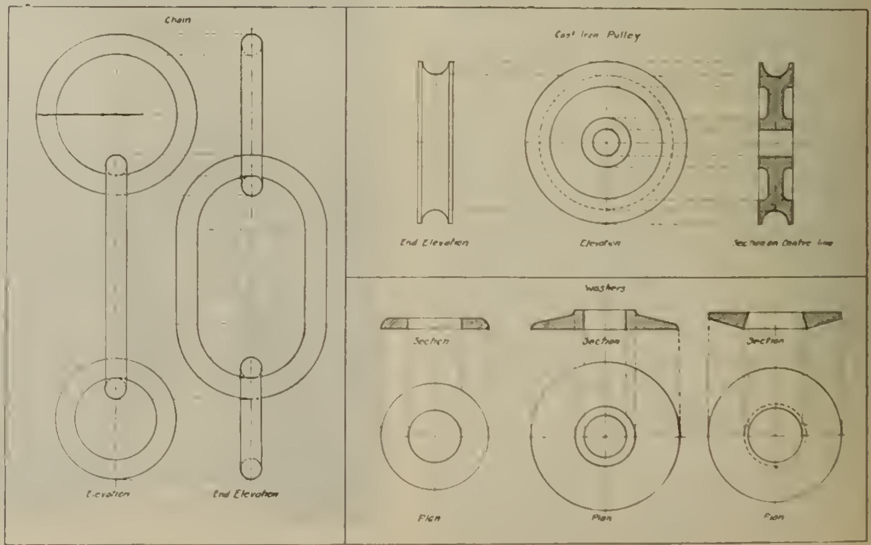


FIG. 16. PROJECTIONS—WORK OF A FIRST YEAR STUDENT.

As the school is situated in the Province of Quebec where the population is largely French, the day courses are given in two languages, consequently the pupils are divided into two distinct groups, for class or theoretical instruction; but both sections are united for practical work in the various shops.

Both the theoretical and practical instruction are very thorough; the former covering arithmetic, algebra and trigonometry, elemental and descriptive geometry, general and industrial physics, electricity, general and applied mechanics, drawing in all its branches and industrial technology.

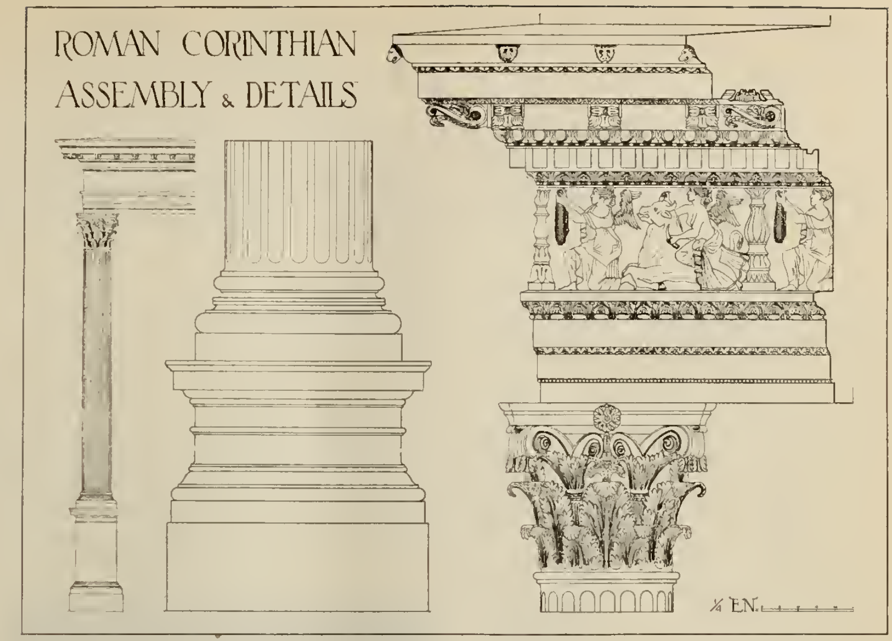


FIG. 18. DECORATIVE ORNAMENT—WORK OF THIRD YEAR STUDENT.

Unless a boy has definitely decided on a future course, the first year at the school is for the purpose of sifting out the bent of each student for certain branches of engineering activity. While a young boy may feel he would like to take up a certain line of work, it is often found that his gifts and inclinations can be developed to far better advantage in some other direction.

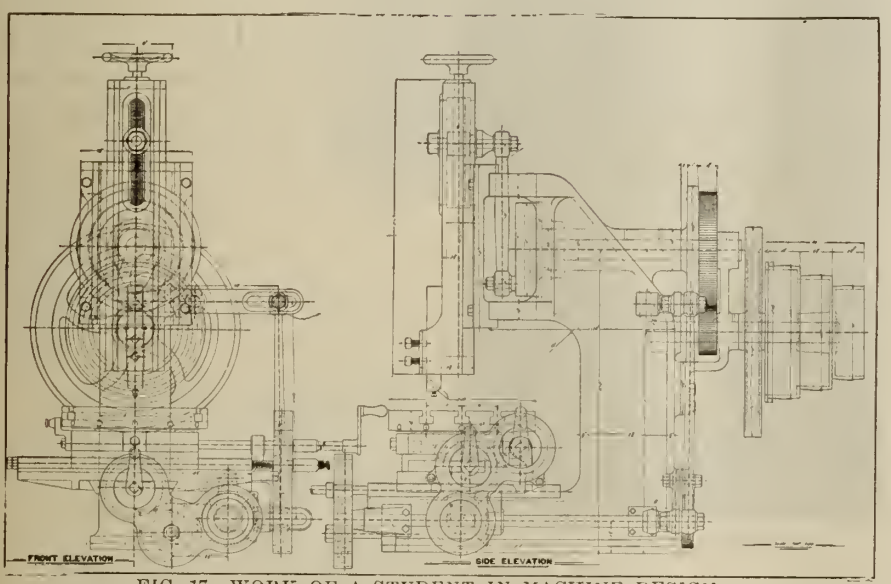


FIG. 17. WORK OF A STUDENT IN MACHINE DESIGN.

While certain rules govern the course of the boys through the various classes, a reasonable amount of latitude is given to each pupil to develop his individual initiative. With this method it has often been found that a dormant mind has been awakened from a state of indifference to one of marked activity.

The normal duration of each course is three years, but those students who have passed satisfactory examinations and been granted diplomas, may, if they so desire, and are duly qualified, take an additional year in advanced work, or specialize in some one branch such as electricity, industrial drawing, automobile construction, etc.

Results of Instruction

It is very difficult to convey to our readers any definite conception of the achievement of the students, as it would be necessary for one to view the work at close range to fully appreciate the remarkable results obtained in the various branches of the school. However, some idea can be conveyed, to the uninitiated, by referring to Fig. 14, which illustrates a section of the exhibition hall. With the exception of the covers on the tables every visible object was constructed by the pupils, and when it is considered that the average age of these boys does not exceed sixteen years, the ultimate result of a few years training is very obvious. The work here exhibited surpasses, in many respects, that of a large number of journeymen mechanics now working at the various trades. A closer view of some of the work is shown in Fig. 4. The left hand panel contains some of the work of the first year pupils in foundry work, while the table display is that of second and third

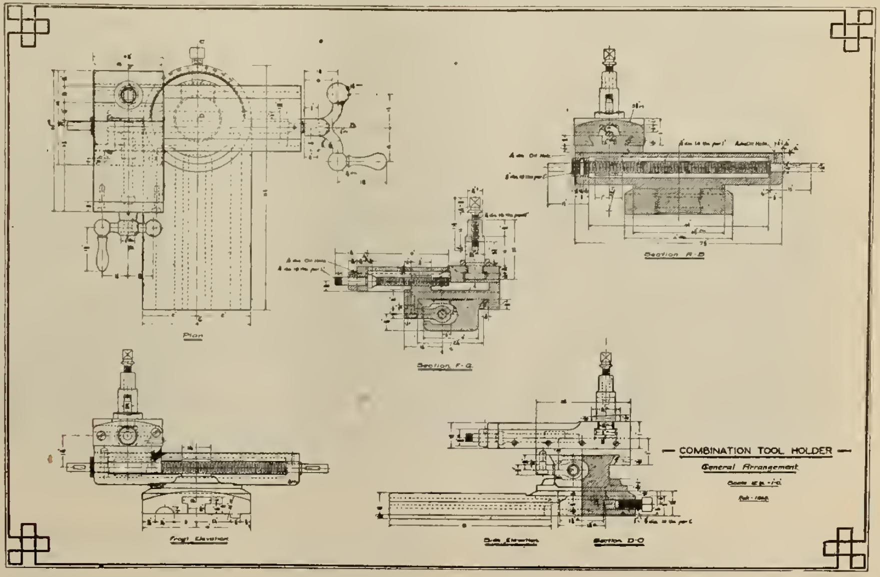


FIG. 19. WORK OF A STUDENT IN MACHINE DESIGN.

year students. The centre panel and the objects directly below illustrate some of the work performed by pupils in forging; while the work to the right is that of the oxy-acetylene department. In addition to the work here shown are several large show cases containing some of the finer work of the machine and electrical classes.

EFFICIENCY TESTS OF C.C. STEAM TURBINE

THE results of a series of efficiency tests on a 30,000 kilowatt cross-compound steam turbine in a power station of the Interborough Rapid Transit Co., of New York, are reported in a paper before the American Society of Mechanical Engineers. It is stated that the thermal efficiency of the turbine was now nearly 25 per cent., equal to that of the gas engine, while the latter involved much higher overhead charges and maintenance costs. For the same reason hydro-electric power, which looked like a gold mine fifteen years ago, was, to-day, not a good investment. Even at Niagara Falls, where the development charge was at a minimum, and where the supply of water was practically unlimited, hydro-electric power could not compete with that obtained from a modern steam turbine station when the load factor was less than 50 per cent.

ELECTRIC LIGHTING OF SMALL TOWNS

IN a paper on the electric lighting of small towns, H. N. Munro says:—There is one great difference between the plant for a small town scheme and that for a power supply in a large city. The latter has, in the first place, to be supremely efficient; cost is, to a certain extent, a secondary consideration. The small plants with which Mr. Munro is concerned are dependent to a great extent on initial cost. It must not be inferred from this remark that efficiency is not of great importance, because it will be obvious that if an inefficient plant is laid down, the system is weak, and will be costly to run—the additional running expenses in a short time will amount to more than the saving effected by purchasing a very cheap plant. Superlative efficiency is not, however, required, but the plant must be reliable, strong, and simple to work, as skilled operators and attendants are not readily obtainable in small places.

Charles Hodgson Osler, civil engineer of the Montreal Light, Heat & Power Co., Montreal died on July 8, aged 56. The deceased was born in Sheffield, England and came to Canada in 1872. He was well known as a locating engineer and in this capacity was with the C.P.R. and C.N.R. for some years.

HARRY WRAY WELLER

HARRY WRAY WELLER, son of George Weller, barrister of Brimington Hall, England, was born in London, January 4, 1858. He was educated at Holton House School, Derby, and passed Cambridge University examination with honors in 1872. His business and engineering career embraces the following engagements and appointments:—

With the Midland Railway, 1873-1876; assistant to Coke & Mills, mining engineers, Chesterfield, 1876-1881; assistant engineer, Pease's West Collieries, 1881-1882; engaged in the United States and London on special engineering work for Col. Stuart Wortley, of London, in 1882-1883; chief assistant to Robert Vawser, tramway engineer, Manchester, 1883-1885; engineer to the Chesterfield Union, 1885-1889, from which position he resigned and returned to New York; with the Sprague Electric Railway Co. as engineer, 1889-1890; with Edison General Electric Co. as special engineer and assistant manager of railway department, 1889-1893; with General Electric Co. and United Columbian Electric Co., 1893 and 1894; and New England manager the Campbell & Zell Boiler Co., 1895-1899. In May, 1899, Mr. Weller came to Montreal to be manager for Babcock & Wilcox, which position he has held for the past seventeen years.

HARRY WRAY WELLER.

During this latter period the installation of Babcock & Wilcox water tube boilers in Canadian manufacturing and power plants has proceeded to a remarkable extent. They are to be found in every province of the Dominion in single and combination units and of boiler horse-power capacities comparable with the largest of their own or other types elsewhere in service. Needless to say, much of the credit in this respect belongs to Mr. Weller's business enterprise and initiative.

Mr. Weller is a Fellow of the American Institute of Electrical Engineers, an Associate Member of the Institution of Civil Engineers, member of the Canadian Mining Institute, a member of the Constitutional Club, London, and of the Engineers' Club, Montreal.

AUTOMATIC SLIP REGULATORS

IN case where a motor is to be applied to a load which has heavy peaks of short duration, a flywheel can often be utilized to advantage. If the speed is allowed to decrease during the periods of peak load, the flywheel will give up part of its energy, so that the load demanded of the motor is less. During the periods of light load the motor returns energy to the flywheel by speeding it up. An induction motor can be applied to such service if it has a drooping speed-torque characteristic, i.e., if its speed decreases considerably as load comes on.

A high-resistance rotor will give this effect, but is inefficient on account of rotor resistance loss. This can be obviated in large machines by the use of an automatic slip regulator. This is a liquid rheostat inserted in the secondary circuit. The electrodes are operated by a motor, which is in turn controlled by the current in the main circuit. When load comes on, the current increases and causes the auxiliary motor to increase the secondary resistance by moving the electrodes or changing the level of the electrolyte. Putting more resistance in the rotor circuit reduces the current and causes the motor to give less torque or else slow down. As the motor slows down, the flywheel gives up its energy to the load and relieves the motor from furnishing the whole load torque. When the peak is over, the motor accelerates the flywheel, the current falls, and the secondary resistance is reduced, thus obviating large secondary loss during the normal load period.

Riveting.—High Pressure boiler riveting is now generally done by hydraulic machines, which have shown themselves superior to any other kind. In consequence of the slow movement of a hydraulic plunger, the rivets have time to enlarge and fill the holes, and, from the solidity of action and steady holding power of the machine, the plates are firmly pressed together, with the result that joints riveted by this type of machine are tighter than those made by any other.

Halifax, N.S.—The head office of the Camaguay Electric Co. has been removed from here to Montreal.

The C.A.S.E. Convention City — Metropolitan Montreal

By C. T. R.

The choice of a Convention City is a matter of considerable importance. Relative values from either or all of the educational, recreative, scenic and social aspects may not be overlooked. In the selection of the Dominion Metropolis for their 1916 Convention and Exhibition, the Canadian Association of Stationary Engineers and their affiliated Exhibitors' Association possibly found the task a light one. Be that as it may, the choice is Canada's best.

THE history of Montreal from the earliest available records, and its growth and development as exemplified in these modern times, are probably more fascinating because crowded with incident and adventure than those of any other city—large or small, on the North American continent. Away back in 1535—nearly 400 years ago—the first white man—Jacques Cartier—broke the spell of ages by landing in a vessel from France under the shadow of Mount Royal. He was followed some seventy years later by Champlain, the founder of Quebec City. In 1642, Maisonneuve arrived, and to him wholly as distinct from the others, who filled more or less the role of discoverers, we owe the initiation and settlement of Montreal on its present day location.

Montreal under Maisonneuve was essentially a religious colony, and while it maintains that distinction still in large degree, it has in these intervening centuries also been of the utmost value as a military centre. To-day, certainly more than at any time in its history, it is the chief industrial and commercial city in the whole Dominion of Canada.

VIEW OF HARBOR OF MONTREAL AS IT APPEARED IN THE YEAR 1830.

In spite of the fact that Montreal is the head of ocean navigation by way of the River St. Lawrence, its most marked growth and development have taken place since our interior provinces became linked with it by railroad steel.

VIEW OF HARBOR OF MONTREAL IN 1872 SHOWING SAILING VESSELS.

The advent of the C.P.R. with a transcontinental service, and the further opening up of new provincial territory by it and other railroad enterprise, these more than anything else have contributed to the phenomenal rise of Montreal as an industrial and commercial centre, and as a national and international port of first magnitude.

Grain Elevators

Chief amongst the many interesting features of the port of Montreal is the elevator accommodation. Prior to 1910 the export grain handling equipment in Montreal harbor consisted of a 1,000,000 bushel elevator owned and operated by the Montreal Warehousing Co.; two obsolete wooden elevators owned by the Canadian Pacific Railway, since torn down; and a fleet of floating transfer elevators of miscellaneous construction and varying age and service efficiency.

Early in 1910 the Harbor Commissioners of Montreal determined to erect a new grain elevator of the highest cla and most modern type, to have a capacity of 1,772,000 bushels, but in 1911 it was found that this extra storage room would be still insufficient to meet the needs of the port, and an extension was begun. The entire plant, known as Elevator No. 2, with a total capacity of 2,622,000 bushels, was put in operation in 1912; not any too soon, however.

DRY DOCK AND SHIP REPAIRING PLANT, CANADIAN VICKERS, LTD.

The grain business increased so much as a result of the additional equipment that the construction of a 1,500,000 bushel addition to No. 1 Elevator was commenced in the spring of 1913, and was in operation at the beginning of 1915 season. Still another addition to No. 1 Elevator was required, and construction was started early last year on the now completion of which the capacity of the port totals as follows:—

No. 1 Elevator	4,000,000	bushels
No. 2 Elevator	2,622,000	"
G. T. R. Elevator.....	2,150,000	"

The full significance of such accommodation and the necessary equipment is realized from the following facts:

OCEAN GRAIN VESSELS LOADING AND WAITING FOR BERTHS. WINDMILL POINT.

Grain can be received from lake vessels and barges at the rate of 40,000 bushels per hour without intermission.

Grain can be received from railroad cars at the rate of 36 cars per hour.

Grain can be delivered to ocean vessels at the rate of 75,000 bushels per hour, and over a wide berth area.

Harbor Railway Terminals

The operation of the railway terminals has proved to be one of the most important and successful features of the development of the port of Montreal.

These terminals reach from Victoria Bridge to Longue Pointe, a distance of seven miles, extending through the adjoining cities of Montreal and Maisonneuve, with a total track mileage of 44.9 miles. The matter of providing through railway connection from all parts of the harbor to all trunk lines of the country began to receive attention in 1914, since when there has been remarkable development in industrial traffic between manufacturing establishments on the water front, and the different Canadian railways.

As a result of the Commissioners' policy, coal, raw materials, supplies and manufactured goods are shunted into the various plants, while manufactured goods and completed articles are shipped out to all domestic points or to steamships in the harbor.

The rates charged for this service are so moderate, and the results so satisfactory that an urgent demand has sprung up for immediate extension of the harbor terminals to new sites, and to the industrial wharves which are being specially constructed.

Shipbuilding and Ship Repairing Facilities

Perhaps the most important factor in the development of the port, next to harbor accommodation, has been the provision of shipyard facilities for the prompt and efficient performance of repairs to either hull or engine. After a considerable amount of construction work, a site was prepared, which includes thirty acres of filled land for shipyard purposes with about six acres additional right-of-way for harbor tracks and roadway. The shipyard site is owned and operated by Canadian Vickers.

A prominent feture of the equipment is the "Duke of Connaught" floating dry dock, which was built at the Barrow works of Vickers, and towed across the Atlantic in September, 1912. The maximum capacity of the dock, which is in three sections, is sufficient for docking ships up to 25,000 tons displacement, and up to 700 ft. in length. The value of such a unit as part of the port equipment is being increasingly recognized each year, a total of twenty-four vessels being docked and repaired during season 1915.

The shipbuilding berth is 500 ft. long, with a clear width of 116 ft. It is entirely enclosed so that work may be carried on continuously, desipte the rigors of a Canadian winter. Engine and boiler shops, electrical construction department, with brass and iron foundries, enable repairs of any magnitude to be performed on vessels of all sizes and propelling machinery of any existing type, be it turbine, reciprocating, or internal combustion engines.

St. Lawrence Shipping

Since 1900 Canada has spent $70,000,000 on the St. Lawrence route, the results showing up very clearly in the steady decrease in losses and accidents.

KING EDWARD VII. MONUMENT.

The value of the St. Lawrence route to Canada's deep inland water connection with interior points was demonstrated during last season, when about 30,00 tons of nitrate of soda from Chile were transhipped at Montreal en route to the Western States, this being the only break in continuity over the entire distance of 10.500 miles.

Among other features of note in the grain trade of Montreal during 1915 are the following: The shipment of 100,000 bushels of grain to New Zealand—the bagging of 2,800,540 bushels of grain at Elevator No. 2—the receipt of the first car of grain over the new Canadian Northern Transcontinental line, on Nov. 18, 1915—the receipt of the first car of grain over the Grand Trunk Pacific, the National Transcontinental Railway and the Grand Trunk System on Nov. 25, 1915. These facts alone justify Montreal's claim to be considered the premier port of Canada.

Apart from the interest that Montreal holds for the visitor as a great ocean shipping port, and of perhaps equal appeal, there are to be noted its myriad and variety industries, its magnificent churches, convents, and public buildings, its unapproached city and suburban car services, its railroad terminals. its amusement and recreation resorts. its mountain, its residences, its hotels, its monuments, its departmental stores, and its many links and associations with a quite distant past, as exemplified in the habits, customs, social and religious life of its people. To one familiar with the City of Montreal, it seems somewhat invidious to single out specific directions in which the convention visi-

GENERAL POST OFFICE AND BANK OF MONTREAL.

tor may spend profitably his whole or part time. Notre Dame and St. James Cathedrals, the Jesuit Church, C.P.R. Windsor Street, and Place Viger Stations, the Central Y.M.C.A., the mountain top by elevator and around the mountain, a ride across Victoria Bridge by Montreal and Southern Counties Electric Railway, are each and all easily worth one's while to include in an ultra-industrial itinerary.

SUMMER IN WESTMOUNT PARK.

In the realms of commerce and manufacture, Montreal, as has been already stated, is king. If visiting privileges are procurable, the following industrial and other plants should be visited. Dominion Bridge Co. and the Montreal Ammunition Co., Lachine; Canadian Car & Foundry Co., and the Canadian Steel Foundries; Canadian Vickers; Montreal Locomotive Co., Northern Electric Co., St. Lawrence Sugar Refining Co., Canada Sugar Refining Co., Canadian Consolidated Rubber Co., Waterman Fountain Pen Co., St. Lambert, High and Low Level Pumping Stations, Montreal City and Montreal Water & Power Co., Dominion Textile, Montreal Tramways and M.L.H.P. Power Stations, Westmount Power Station, C.P.R. and G.T.R. Locomotive Shops, etc.

AT ST. ROSE, A POPULAR HOLIDAY RESORT OF MONTREALERS.

C.A.S.E. CONVENTION AND EXHIBITION

THE 27th annual convention of the Canadian Association of Stationary Engineers, and its affiliated Supplies Exhibit to be held in Montreal from July 24 to 28, inclusive, give promise to outstrip in their every feature the most meritorious of similar ventures and experiences. Aside from the actual business and pleasure programs drafted, the local "atmosphere" will be an added factor in both directions. The rejuvenated Montreal lodge is perhaps now the strongest, most active and progressive of any under the wing of the C. A. S. E., and as regards the exhibit feature, it may be affirmed that it, too, is being afforded a scope and opportunity to be found nowhere else in Canada.

Questions of graded certificates, their acceptance uniformity throughout the various provinces of the Dominion, and uniform boiler construction laws, also applicable to all Canada, will doubtless be live topics for sessional discussion. Opportunity should be taken to give the fullest possible prominence to the aims and efforts of the Canadian Association of Stationary Engineers in a live industrial centre, such as Montreal. In this connection it is suggested that executive deputations wait on the leading manufacturing and power plant managements for the purpose of eliciting their views on and procuring their support for association schemes projected and in course of development towards both higher standard operator efficiency and towards the removal of the already mentioned interprovincial disabilities. Not only are Montreal's industrial interests powerful, but they are alert and keen to cooperate in any reasonably advantageous and and mutually beneficial enterprise.

MAISONNEUVE MONUMENT.

The duration of the convention and exhibition has on this occasion been extended by one day, the decision to do so being we think a wise one. There will in consequence, be more time for fruitful work, more time for pleasure and sightseeing, and more justice will be done the Exhibitors' Association, whose display promises to be unusually valuable and attractive.

Convention Programme

The following tentative programme has been arranged. The convention meetings and exhibit will be held in the Montreal Technical School Buildings.

Monday, July 24

The official opening will take place at 10 a.m. on this date, the Provincial Minister of Public Works participating.

Tuesday, July 25

While the engineers are in session, the lady guests will in the morning be treated to an automobile ride in and around the city, and to a car ride and visit to Dominion Park in the afternoon. The exhibition will be open throughout the day for convenience of the public.

Wednesday, July 26

Following a convention session in the forenoon, delegates, exhibitors, and guests will proceed to St. Anne de Bellevue by G. T. R. train, visiting there the MacDonald College, and bringing off the annual ball game between teams of engineers and exhibitors. The return trip will be made by steamer, and will include shooting the Lachine Rapids.

Thursday, July 27

All day business sessions of engineers followed by election and installation of officers for ensuing twelve months. Annual meeting of Exhibitors' Association, transaction of general business, and election of officers for ensuing year.

Friday, July 28

Closing exercises and get-away day.

List of Ehibitors.

Ross & Greig, Montreal, Que.
Goldie & McCulloch, Galt, Ont.
Canuck Supply Co., Montreal.
Geo. W. Cole, Toronto.
Gutta Percha & Rubber Co., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal and Toronto.
Joseph Dixon Crucible Co., Jersey City, New Jersey.
Peerless Rubber Mfg. Co., New York.
Canadian Asbestos Co., Montreal.
Canadian Powers Regulator Co., Toronto, Ont.
Dunlop Tire & Rubber Goods Co., Toronto.
Morrison & Dagnell, Montreal, Que.
Armstrong Cork & Insulation Co., Montreal and Toronto.
Garlock Packing Co., Hamilton, Ont.
Montreal Council, C.A.S.E.
Canadian Allis-Chalmers, Toronto, Ont.
Canadian H. W. Johns-Manville Co., Toronto.
Goodyear Tire & Rubber Co., Toronto.
Electrical Equipment Co., Montreal.
Canadian Consolidated Rubber Co., Montreal
The Lunkenheimer Co., Cincinnati, Ohio.
Lytle, Smith & Co., Montreal.
Economy Fuse & Mfg. Co. of Canada, Ltd., Montreal.
Darling Bros., Montreal.
Sadler & Haworth, Montreal.
Lyman Tube & Supply Co., Montreal.
Dearborn Chemical Co. of Canada, Ltd., Toronto.
Jenkins Bros., Montreal.
Canadian Griscom-Russell Co., Montreal.
S. W. Gates, Montreal.
H. L. Peiler, Montreal.
Canadian Vincent Valve Co., Victoria, B.C.
The "Canadian Manufacturer," Toronto.
Dart Union Co., Toronto.
C. B. Turner, Toronto.
"Power," New York.
T. McAvity & Sons, St. John, N.B.
"The Power House," Toronto.
Standard Sanitary Mfg. Co., Toronto.
James Morrison Brass Mfg. Co., Toronto.
Dominion Belting Co., Hamilton, Ont.
Erie Pump & Equipment Co., Erie, Pa.

CONSTANT SPEED, VARIABLE VOLUME AIR COMPRESSOR

IN order to operate the extensive equipment at the Hollinger Gold Mines, there has recently been installed at their plant at Timmins, Ont., a large Fraser & Chalmers constant speed, variable volume air compressor. This machine, shown in the accompanying illustrations is direct connected to an 800 b.h.p. synchronous motor, three-phase, 25-cycles, 12,000 volts, having a speed of 125 revolutions per minute. The rotor is made in two halves, mounted on the crank shaft, and so designed as to give the necessary fly-wheel effect; the total weight of the rotor being approximately 17,000 pounds. Crank shaft is of steel, 20 inches in diameter, 17 feet long and weighs about 16,000 pounds. Main bearings are fitted with four-part boxes of cast iron, and babbitted. Sides and bottom boxes are made adjustable by means of wedges and screws, for taking up wear.

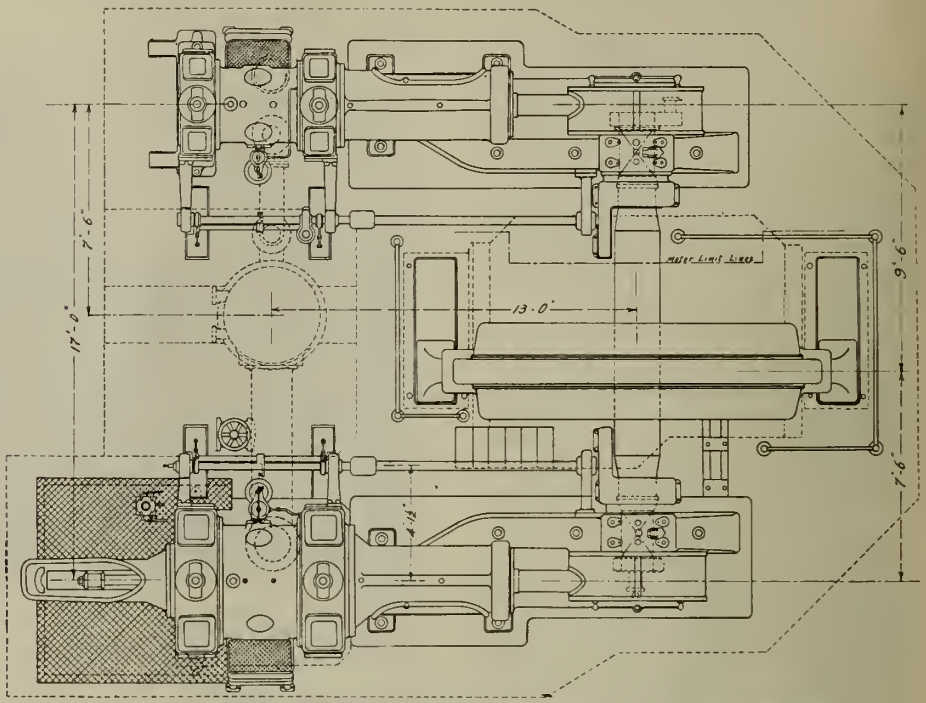
Cylinders are made of hard cold blast iron, barrels being cast with a liner to form a water jacket space around the cylinder. The high pressure cylinder has a diameter of 22½ inches, the low pressure cylinder a diameter of 38 inches, the uniform stroke being 30

C.A.S.E. EXHIBITORS' ASSOCIATION EXECUTIVE.

Lloyd Archibald, 2nd Vice-President, Dart Union Co., Toronto; Wm. G. Forbes, Hon. President, Montreal; H. L. Peiler, President, 380 St. James St., Montreal; C. G. Peterson, 1st Vice-President, Griscom Russell Co., Toronto; H. J. Ramshaw, Garlock Packing Co., Hamilton; W. F. Floyd, Assistant Secy., Quaker City Rubber Co., Buffalo; E. F. Hetherington, Chairman of Exhibits, Goldie & McCulloch Co., Galt; Wm. R. Stavert, Chairman Entertainment Committee, Jenkins Bros., Montreal; Jas. E. Fiddes, Treasurer, Standard Sanitary Mfg. Co., Toronto; G. C. Keith, Secretary, Editor "The Canadian Manufacturer," Toronto; E. L. Foley, Chairman Reception Committee, Canuck Supply Co., Montreal.

inches. Four removable covers are located in the outer casing, for cleaning out dirt or other foreign matter that might settle in the water jacket. Cylinder heads or valve chambers are cast seperate and bolted to the barrels, each head being fitted with suction and delivery valves of the Hoerbiger-Rogler patent frictionless guide type. The suction and delivery valves are made of forged steel, as light as possible contingent with strength, and are designed to automatically open and close without assistance.

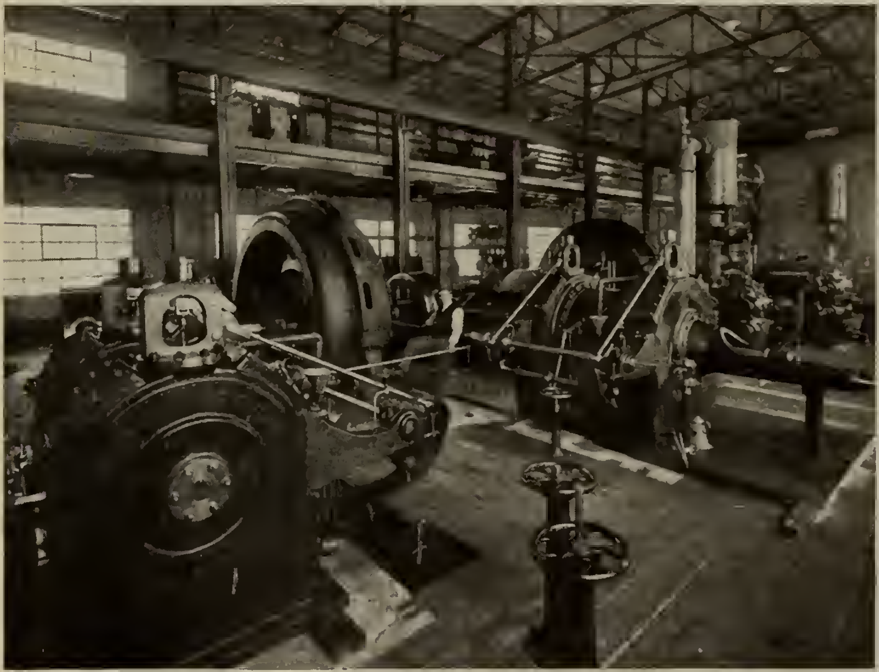
Front heads are connected direct to the guides, and have stuffing boxes and glands complete, with Tripps metallic packing. The cylinders themselves are fitted with patent poppet unloading valves at each end, and are operated by eccentrics from a lay shaft on the high and low pressure side, driven by bevel gears off the crank shaft. The throw of these eccentrics, and the lift of the valves, are controlled by air governors (one on each cylinder), to regulate the amount of air to be delivered. Covers are arranged on each head to provide easy access to the valves and seats. Special valves are located in the discharge pipes, for opening to the atmosphere on starting up, and so reduce the starting torque to a minimum.



INSTALLATION PLAN OF LARGE CONSTANT SPEED, VARIABLE VOLUME AIR COMPRESSOR.

Air coolers, specially designed to suit local conditions, are installed in the basement. They are of the vertical type, arranged so that the tubes can be lifted out in one nest for cleaning purposes, without delay in operation. They consist of mild steel shells with cast iron covers. The interior cooling tubes are of brass, expanded and secured in muntz metal tube plates. Cold water passes through the tubes, the air across same being directed by means of baffle plates.

Forced lubrication is employed in the oiling system being supplied from a rotary pump. A tank is also installed to give a constant head of 15 feet on the bearings, in case anything goes wrong with the oil pump. When oil pressure falls below 5 lbs., it automatically feeds from the tank, at the same time ringing an alarm. A separate mechanically operated oil pump is used to lubricate the cylinders when under the air pressure.



ENGINE ROOM SHOWING AIR COMPRESSOR IN FOREGROUND

The capacity of this machine is 4,500 cubic feet of free air per minute at 1,100 feet altitude, same being compared to a pressure of 105 pounds per square inch gauge. Volumetric efficiency is 93 per cent., and a corresponding mechanical efficiency can be maintained when operating under full load conditions.

INTERESTING AIR LIFT INSTALLATION

THE air lift pumping plant described is installed at the National Transcontinental Railway yards, near the Quebec Bridge. The work was started in September, 1912, forty-three feet of 8-in. wrought iron pipe being driven from the surface to the rock, and from that point a 5-in. bore hole was started. The well was drilled entirely in shale, red and gray alternating. On September 30 a depth of 400 feet had been reached, and a rough pumping test yielded 200 Imperial gallons per hour. At 280, 520 and 700 feet respectively dry crevices were encountered, while at 775 feet water was struck in considerable quantity. The hole was then reamed to a diameter of 8 in., and a subsequent test yielded 3,200 Imperial gallons per hour.

At a depth of 980 feet, another water crevice was opened up, and at a depth of 1,012 feet drilling was discontinued. The whole well was then reamed out to 8 in. diameter. A large plunger pump was used for a 24-hour test, and with 400 ft. of rods in the well a yield of 5,400 Imperial gallons per hour was maintained. This pump was afterwards operated for eight days to clean out the well, and a sample of water was analyzed and reported satisfactory for both boiler and domestic purposes. When the well is not being pumped, water rises to the surface; but when being pumped to capacity it drops to a depth of 400 ft. from the surface.

Principal Equipment Items

A joint contract was awarded to the Canadian Ingersoll-Rand Co. and Williams & Wilson, of Montreal, for furnishing and installing a suitable pumping plant, the air-lift system being finally adopted because of its lack of moving or wearing parts in the water, and because the air-compressor could be located any distance away from the well.

The air-compressor is a Canadian Ingersoll-Rand tandem compound, steam-driven machine, designed for a terminal pressure of 250 pounds, the air cylinders being fitted with a new type of valve known as the Cir-co-leaf valve, which is claimed to be absolutely noiseless in operation. The frame is fully enclosed, and the moving parts work in a constant flood of oil. A combined speed and pressure governor controls the compressor.

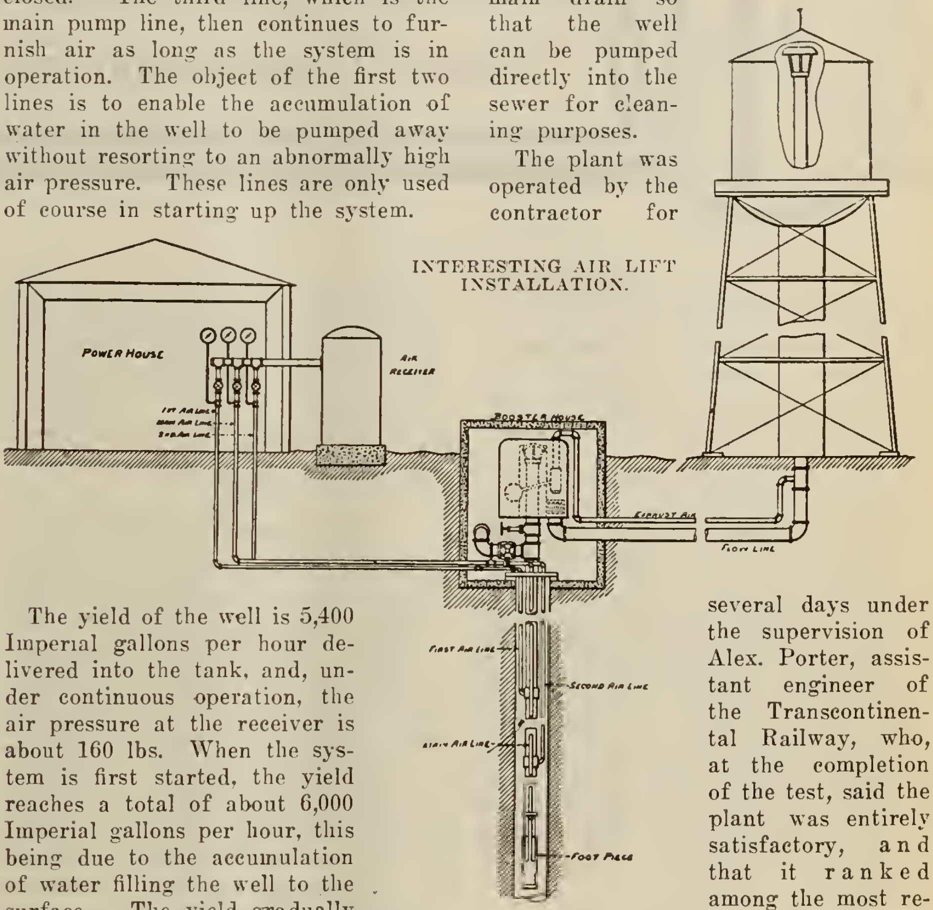
The air-lift foot-piece was manufactured by the Harris Air Pump Co., of Indianapolis, whose pumps are extensively installed throughout Canada. The column of water is carried by an air-jet situated below a choker, which arrangement eliminates slippage and causes the air to be distributed through the water in small bubbles. The booster pump was also furnished by the same firm.

Water is discharged into a steel tank 24 feet in diameter, and the total capacity, including the leg, is 61,170 Imperial gallons. The level of the water in feet is indicated by a register on the outside of the tank, by which means it is possible to accurately gauge the capacity of the plant. The tank is supported by a steel frame resting on a concrete base, in which are located the valves and connections to the service mains and to the main drain. Steam is furnished to the compressor at 110 lbs. pressure.

Air Line Features

Owing to the depth to which the water drops in the well, three air lines are used, two being tapped into the water discharge line at different depths, and the third entering the Harris foot-piece. Each of these three air lines is controlled by a gate-valve in the power-house, the engineer operating the system without going near the well, which is 250 ft. from the power-house. A gauge over each line shows the pressure and indicates the fall of the water in the well.

Air discharges from the compressor into a high-pressure air-receiver and there to the well. The first air line starts the water flowing and continues to pump until the well lowers as far as this line is capable of lowering it. Then the first air line is gradually turned off until the second line begins to act. When this line has lowered the water as far as it is capable of doing so, the work is taken up by the third line and the second line closed. The third line, which is the main pump line, then continues to furnish air as long as the system is in operation. The object of the first two lines is to enable the accumulation of water in the well to be pumped away without resorting to an abnormally high air pressure. These lines are only used of course in starting up the system.



INTERESTING AIR LIFT INSTALLATION.

The yield of the well is 5,400 Imperial gallons per hour delivered into the tank, and, under continuous operation, the air pressure at the receiver is about 160 lbs. When the system is first started, the yield reaches a total of about 6,000 Imperial gallons per hour, this being due to the accumulation of water filling the well to the surface. The yield gradually decreases under continuous operation until the normal capacity and pumping head have been reached.

At the surface the water has to be pumped horizontally a distance of 60 ft., and subsequently to a height of 90 ft. into the top of the steel tank. For this work a Harris booster operates in conjunction with the air-lift. This booster consists of a steel tank resting on the top of the well-casing and receiving the water as it discharges from the well. The operating parts consist of a float and valve located inside the tank. The water and air are separated in this tank, the air rising to the top and maintaining sufficient pressure to force the water to the elevated tank. As the solid column of water discharges, the float drops, allowing the surplus air to exhaust from the tank. This whole operation requires only a few seconds, as a discharge takes place every time the booster is about two-thirds full. In fact, practically a constant flow is maintained.

The surplus air may be piped back to the compressor intake or discharged into the vertical riser to lighten the column of water and reduce the operating pressure. This latter plan was followed in the case of the plant at Quebec. The booster is automatic in operation and requires no attention. It also operates without noise. This apparatus is located in a concrete sump below the ground and is reached through a door in the roof. A by-pass is connected to the main drain so that the well can be pumped directly into the sewer for cleaning purposes.

The plant was operated by the contractor for several days under the supervision of Alex. Porter, assistant engineer of the Transcontinental Railway, who, at the completion of the test, said the plant was entirely satisfactory, and that it ranked among the most reliable of the various railway divisional pumping units. The high lift is a noticeable feature, amounting as it does to about 500 ft. vertically and 60 ft. horizontally. It demonstrates as far as it goes that there is practically no limit to the height to which the air lift will raise water if a fair submergence is obtainable.

Test Data

On a test recently made the plant pumped nearly 6,000 Imperial gallons per hour; but, as already stated, this capacity was due to accumulated water, and was, of course, only temporary. The normal capacity, 5,000 Imperial gallons per hour, was developed continuously after the level dropped to 400 ft., at which point the running pressure was 160 lbs. per sq. in.—Compressed Air Magazine.

⁂

T. E. Lewis, a British inventor, has patented an engine which he claims incorporates an entirely new principle. It is stated that this new engine retains its efficiency unimpaired in the case of gas, steam, oil, petrol, or air, and can be made a rotary or stationary type. It dispenses altogether with the use of cranks and connecting rods, while the speed attained and the regularity of movement are said to be phenomenal.

Power Transmission Section

TRANSMISSION SAFETY—II.

DUE to the high speed often attained by belts, it is necessary to make adequate provision for shifting them with safety. Approved mechanical belt-shifters should be provided in each case, in connection with tight-and-loose pulleys; and it is advisable to have these shifters equipped with rollers where they come in contact with the belts. This not only reduces the wear on the edges of the belts (which may be considerable in the course of a year), but also minimizes the chance of the ragged edge of a belt catching in the belt-shifter and causing damage. The belt-shifter should be provided with an approved automatic locking device, and the handle of the belt-shifter should be located so that the workman can operate it from his regular working position without inconvenience.

Belt Shifting Methods and Devices

A very common risk is run in connection with the shifting of belts by allowing an unshipped belt to ride on the revolving shaft. Such a belt, especially when loosely joined by lacing, may gradually travel around until the joint reaches the shaft, then be drawn tight enough to engage the driven pulley, and thus suddenly start the machine. This is particularly true of small pulleys, and though this specific danger may appear to be remote, we could cite cases in which it has led to serious consequences. For this reason, it is far better to hang the unshipped belt on a suitable book or belt-perch.

Although we strongly advocate the installation of mechanical belt-shifters for all machines, we are well aware that in many plants the shifting is still done by hand, or by the use of poles. Hand-shifting is too dangerous to be tolerated under circumstances, and the use of a pole or stick adds but little to the safety of the operation. A recent accident may be cited as an illustration of the danger. While an employe was shipping a belt by means of a stick, the stick slipped between the arms of a moving pulley and was forced back into the workman's side. Two of his ribs were broken, and internal injuries also resulted. This accident could not have occurred if tight-and-loose pulleys and a suitable mechanical belt-shifter had been installed previously. An even more dangerous procedure is that of removing or shifting belts with the feet. Employees who persist in this practice should be severely disciplined.

Belt Dressing Application

The operation of applying dressing to belts to prevent them from slipping leads to many serious accidents. Care should be taken to apply the dressing at the point where the belt leaves the pulley, and to roll up the sleeves so that they will not catch upon belt fastenings or other parts of the belt. It is hardly feasible to stop the belt while the dressing is being applied, because it is then very hard to reach all parts of the belt, and to apply the dressing smoothly and uniformly. The safest and best way, without doubt, is to remove the belt altogether, when it needs dressing, and stretch it out along a bench or on a clean floor. It should then be thoroughly cleansed and repaired after which the new dressing may be applied and worked in. There are few shops, however, in which the superintendents are willing to have the work done in this way, because it involves a considerable expense for labor, and it will also be necessary, in many cases, to have extra belts on hand, to take the places of those that are being cleaned and dressed. Small belts can be handled in this way without any very heavy expense, and in such cases it is possible to do the work outside of the regular hours, so that it will not be necessary to provide extra belts. It is not feasible, however, to remove large, heavy belts and treat them in this way, on account of the great labor involved.

Running Belt Treatment Precautions

If a belt must be dressed while it is running, the work should be assigned to a man who is known to be intelligent and cautious, because in such cases the problem of accident prevention is probably at least 75 per cent. a human problem. In other words, it will depend mainly upon the man himself, whether he is injured or not. Liquid dressing should first be warmed so that it will flow freely, and it should then be applied by a brush and never by the use of rags or cotton waste, because either of these is likely to catch on belt fastenings or rough places in the edges of the belt, and be drawn against the belt along with the man's hand. Experts often recommend that the engine (or motor) driving the belt be slowed down while the dressing is applied. This is a wise precaution, where it can be done satisfactorily.

In dressing a moving belt, the dressing, as previously stated, should be applied to the belt near the point where the belt **leaves** the pulley. Sometimes this is not practicable on account of local conditions, and in such cases extraordinary care should be taken.

Typical Example

We recall a case, says the Travellers' Standard, in which a belt two feet wide, runing over a six-foot pulley, had to be dressed under such conditions that the only part of the belt that was accessible was the part that was within two feet of the pulley, on the in-running side. Moreover, the belt could be approached only on one side, so that the man who applied the dressing had to reach over to the further side of the belt from where he stood. To guard against accident he was in the habit of removing his jumper and rolling his right shirtsleeve up into a tight roll as near as possible to his shoulder, working with his right arm bare.

When conditions of this kind have to be met, a stout railing should be provided for the protection of the man, and it should be placed so that he can lean upon it if necessary, and so that he can catch at it and thus save himself, in case he should lose his balance. When a man is engaged in any perilous operation, of this kind, care should be taken to prevent his being startled by any unusual sound or other disturbing cause. Nobody having ragged or loose-fitting clothing should be allowed near a rapidly-moving belt at any time, either to apply dressing to it or for any other purpose.

Guarding Chain Drives

One type of transmission apparatus that should certainly be closely guarded is the chain drive. The hazard of this drive is about the same as that of gearing. Most chains are installed in a horizontal or nearly horizontal position, so that both sprockets are within reach of the workman. He is then in danger of having his hands or clothing caught between the chain and the sprockets. It is essential, for proper safeguarding, that both the chains and the sprockets be completely inclosed.

Fall of Overhead Shafting

Another hazard that must be considered in shops is that due to the fall of overhead shafting. This sort of accident is somewhat rare, because the danger is so obvious that even the most careless managers usually take precautions against it; but when a section of shafting weighing tons and running the length of the building does fall, enormous damage is likely to be caused. To much care cannot be exercised in making sure that the supports for line shafting are substantial, and that they are securely fastened. A weak or insecure hanger imposes an extra burden on the other hangers, and the shaft is ultimately thrown out of alignment. It then moves with an eccentric motion, which gradually becomes more pronounced as the other hangers are affected by it and work loose. The belt becomes tighter during one part of a revolution of the shafting than during the remaining part, and finally a time will come when a heavy load is applied at the moment when the belt is abnormally tight, and then the whole line of shafting may be pulled down with disastrous results, life and material.

* * *

MICHELL JOURNAL BEARING

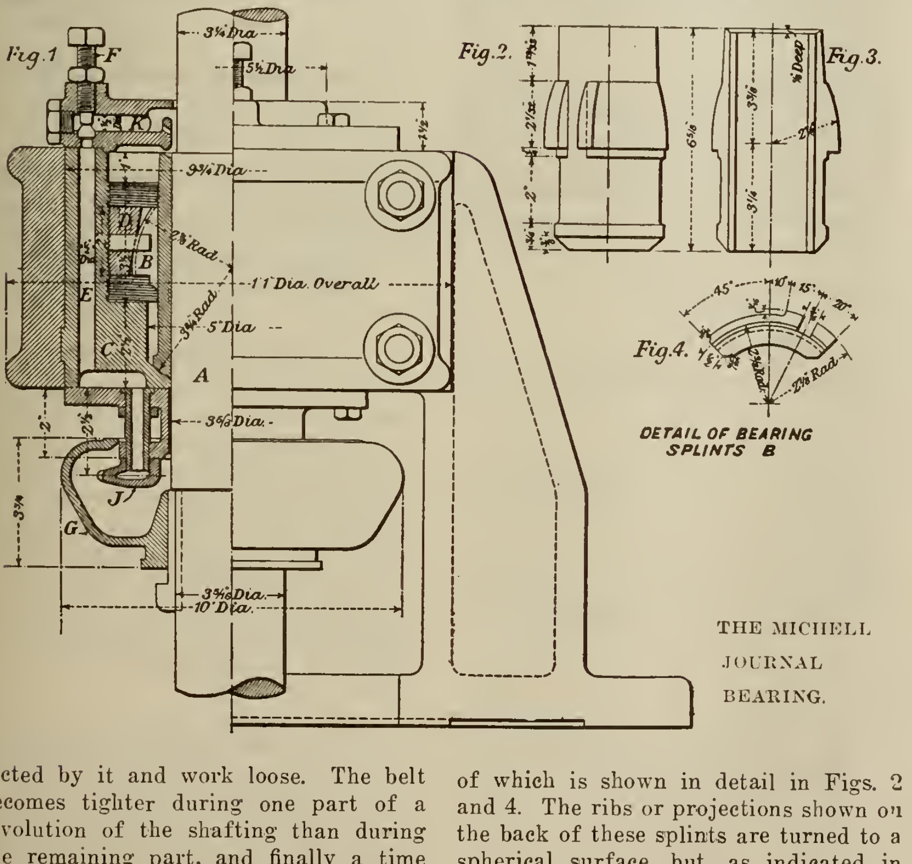
THE Michell principle of thrust absorption has proved so successful as applied to thrust-blocks that there has naturally been a strong inducement to extend its application to ordinary journal bearings. The bearing which is illustrated in Figs. 1 to 4 shows a development of the latter. The bearing represented has been applied to two circulating pumps at the Newport Power Station, Melbourne, Australia. The pumps were made by the G. Weymouth Proprietary, of Melbourne, anl are of 220 horse-power, the shaft speed being 490 revolutions per minute.

As will be seen from Fig. 1, the shafts are vertical, and, as is well known, satisfactory lubrication is in such case a matter of some difficulty owing to the tendency of the oil to run out at the bottom. In the bearings illustrated, however, this difficulty is completely overcome. There is a definite oil circulation, which is maintained by the rotation of the shaft, and leakage of oil entirely prevented. The journals have, we are informed, been running satisfactorily for some months.

Referring to the illustrations, it will be seen that the shaft A is surrounded by four splints or brasses B, the design of which is shown in detail in Figs. 2 and 4. The ribs or projections shown on the back of these splints are turned to a spherical surface, but, as indicated in Fig. 4, this surface is cut away one-sixteenth clear on the side of the leading edge of the splint, so that when in position the brass can tilt a little to facilitate the entrance of oil between the lubricated surfaces. The lower ends of the splints are also turned to a special surface struck from the same centre as that to which the ribs are turned. The splints rest by these spherical surfaces on the housing C of the bearing. A hollow cone D is screwed down on to the ribs of the splints, holding them in position as indicated. By screwing this cone up or down, the oil clearances between the brass and journal surfaces can be adjusted. It will be seen that by this arrangement the bearing is set up towards the centre of the shaft from four directions, instead of from two, as with ordinary two-part brasses.

The lubricating oil draining from the bearing falls into the cup G, which is keyed to the revolving shaft. Dipping into this cup is a nozzle J, and the oil carried round by the rotation of the cup rushes up this nozzle and through the passage E to the top of the bearing, whence it is distributed through the port K. The amount of oil pumped can be controlled by screwing up or down the set-screw shown at F. A continuous circulation of oil between the rubbing surfaces is thus secured.

H. T. Newbigin, A.M.I.C.E., 3 St. Nicholas Building, Newcastle-on-Tyne, is the representative of the device in Great Britain



THE MICHELL JOURNAL BEARING.

* * *

VALUE OF BELT TIGHTENERS

Professor William W. Bird, of Worcester Polytechnic Institute, with Francis W. Roys, have been experimentally investigating the effects of atmospheric humidity upon oak tanned leather belting, with the following definite conclusions:

1.—If a belt be set up at a low relative humidity, slipping will occur with a marked rise in the humidity, especially if it is accompanied with a rise in temperature.

2.—If a belt be set up at a high relative humidity, excessive stretching and excessive pressure on the bearings will result from a decided decrease in the relative humidity, especially if accompanied by a fall in temperature.

3.—If a belt be set up at a medium relative humidity the tensions will not be excessive at low relative humidities nor will there be any great danger of slipping at high relative humidities unless accompanied by excessive temperature changes.

4.—If a belt be set up at any relative humidity with a spring or gravity tightener, a load 50 per cent. greater than the standard can be transmitted at either high or low humidity without any of the troubles.

Light, Heat and Ventilation

DATA RELATIVE TO HEATING AND HEATING SYSEMS—III.*

By T. W. Reynolds.**

PRECAUTIONS are necessary in a one-pipe system that the piping alignment is so correct, and that no sagging occurs as to cause pockets in which water may accumulate and produce hammering. The pipes should be held in position with substantial hangers and due allowance made for proper expansion and contraction. One great advantage of the one-pipe system is that there is only one valve on each radiator to operate and get out of order, with corresponding economy in first cost and maintenance. There are also fewer unsightly pipes to take up and collect dust or in which leaks may occur.

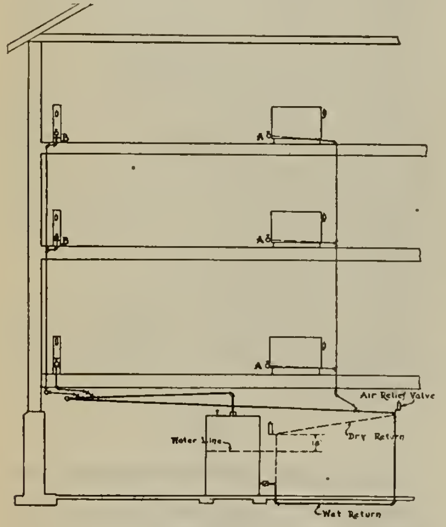


FIG. 1. ONE-PIPE GRAVITY STEAM SYSTEM.

One Pipe Circuit Hot Water System

Fig. 2 shows a method of installing a one-pipe circuit system of hot water heating. The proper method of installing the piping for this system is to stop the main rather close to the top of the boiler carrying it upward at a slight angle until one or two radiator connections have been taken off, at which point the main should be as close to the ceiling of the basement as possible; and from this point carrying the main downward at a slight angle as far as the last radiator connection. From the point of the last radiator connection the main should pitch rapidly back to the lowest opening in the boiler. In this type of hot water plant the main must be of very ample size to bring about a rapid circulation around the main loop. The amount of hot water received by the last radiators on the circuit will depend on how rapidly the water in the main circulates.

The flow pipes which lead to the radiators should be taken off the top of the main, while the return pipes bringing the water back should be connected into the bottom of the main. This method of making the connections at the main makes it possible to get the hottest water, which is at the top. Short straight runs are essential to the successful operation of this system, as is usually present in residential work, otherwise the mixing of the hot and cold water would be more intimate, which is naturally not to be desired.

One valve for each radiator is all that is required, a union ell being used at the opposite end of the radiator. The radiation on the first floor should have the preference and be supplied direct from the main supply with a direct connection to the main return. The branches nearest the boiler should have the least pitch. Since the hot water has a tendency to rise to the radiators on the highest floors and neglect the lower floors, it becomes necessary to restrict the flow of water by some such method as is shown by the connection F (Fig. 2). In general, this same feature applies to all hot water systems (see Figs. 4, 6, and 7). It is very important to avoid pockets or traps in the pipe lines, which have a tendency to resist the flow of water.

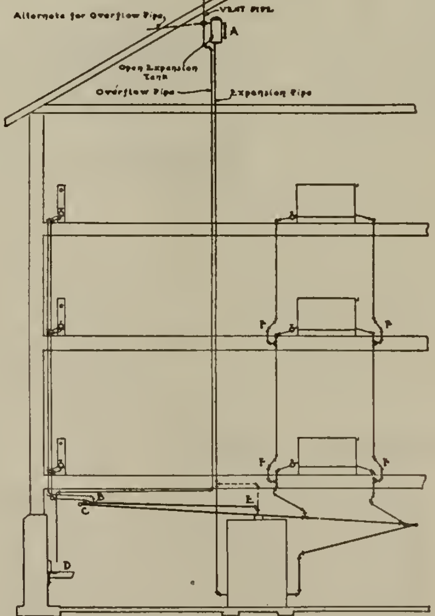


FIG. 2. ONE-PIPE LOOP HOT WATER SYSTEM.

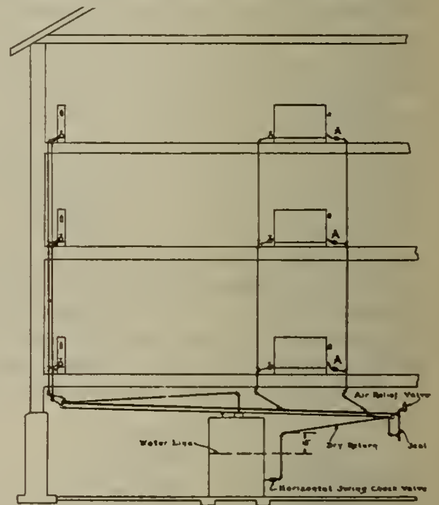


FIG. 3. TWO-PIPE GRAVITY STEAM SYSTEM.

Two-pipe Steam System

In connection with the two-pipe system for steam, it is best to use a wet return. In such a system the supply main, or mains, if more than one be used, is carried vertically above the top of the boiler to the ceiling of the basement or cellar, and then in the direction of the radiators to be supplied. If a dry return is used, the end of the supply main should be relieved of its condensation by means of a trapped connection to the return.

Fig. 3 is a diagrammatic representation of a two-pipe gravity system of steam heating. It is advisable, when possible, to carry a return riser from each radiator separately to the return in the cellar and make the connection below the water line of the boiler as the circulation will be more positive and the steam cannot enter the radiators from more than one direction causing water hammer. The diagram shows the common way of installing this system. Two valves are required, one on each of the supply and return ends of all radiators.

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*Parts I. and II. appeared in our March and April issues.

**Of McMullen, Riley & Durley, Toronto.

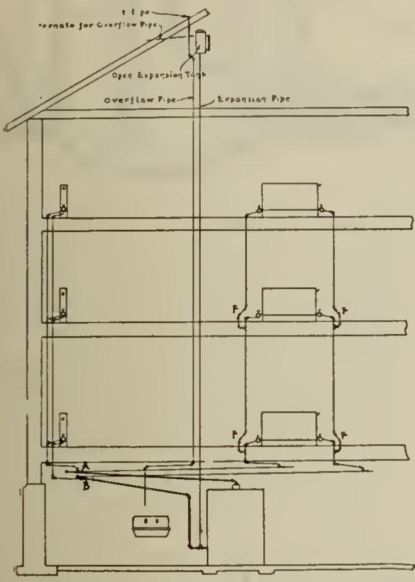

FIG. 4. TWO-PIPE OPEN TANK HOT WATER SYSTEM.

The use of a horizontal swing check valve on the return end of each radiator (See A, Fig. 3), and a water trap having a seal of 18-in. to 25-in. at the end of the main prevents steam from entering the radiators from more than one direction, and also eliminates the necessity of opening or closing more than one valve when a radiator is operated. The water seal should have some provision for cleaning out. A tee at its base with a nipple and cap is sufficient for this purpose. If the ordinary steam valve is used at A (Fig. 3), instead of the check valve, there is a greater liability to water hammer in the radiator, because of condensation being forced back through the return pipe into the radiator. If the check valve is omitted, the hand valve on the return should first be opened or closed when operating the radiator.

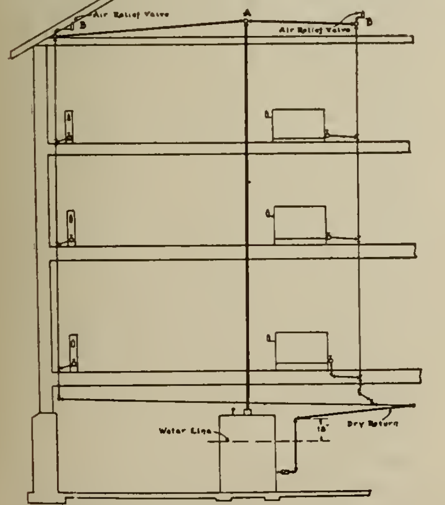

FIG. 5. GRAVITY STEAM ONE-PIPE OVERHEAD SYSTEM.

"Impulse" Valve on Radiator Return

Mention should also be made of a well-known system which employs weighted swing check valves, or so-called "Impulse" valves on the return end of each radiator. The weight over area of the seat, together with a restricted orifice produce a difference in pressure between the steam and return mains irrespective of the pressure carried. To make this system complete when installed on an ordinary two-pipe installation, there is required one (and one only) main air valve connected to the return mains in the cellar at a point well above the water line in the boiler. All air in the system is expelled through this valve. This system has many advantages such as the elimination of the usual whistling air valve on each radiator together with its first cost, and the graduation of the inlet valve so as to secure a partial heating of the radiator; while the return of water to the radiators is prevented by the ordinary automatic with the use merely of an ordinary gate or globe valve on the inlet end instead of the usual modulating valve. Again, due to it being a closed system there is no limit to the pressure carried except as fixed by the setting of the safety valve. The impulse valves may also be used on indirect stacks and large heating units, such as coils or wall radiation running into several hundred square feet per unit. Such amounts are however seldom encountered in the average residence.

The two-pipe system requires smaller pipes than the one-pipe system of steam work, since, in the former, the steam and water are each carried in different pipes. For this reason there is less chance of trouble from water hammer in the two-pipe work. The same precautions, however, for avoiding pockets in the mains and branches must be observed, and the installation must be as carefully aligned and supported as one-pipe work. The steam should flow through the main in the same direction as the condensation. The minimum allowance for pitch of both supply and return pipes should be one inch in 15 feet.

Two-Pipe Open Tank Hot Water System

Figure 4 shows a two-pipe open tank hot water system. In this there may be more than one supply and one return main, but generally the best results are obtained from one large supply and an equal size return main. The supply and return risers are run in pairs, and each radiator has a supply and return pipe of equal size. The first radiators which are connected to the main nearest the boiler may be retarded in some such way as by making their connections with the mains through a side opening or by adding extra fittings which produce excess friction. As in one-pipe hot water work, only one valve is required for each radiator unit. a union ell being used on the return end. Special precautions must be taken to avoid all unnecessary turns and fittings in the mains. Pockets or depressions should be avoided as they retard or trap the circulation. The best results are obtained where pipes are of full size and installed with a good pitch. The flow main should rise continually from the boiler and the return pipe should be gravity graded toward the boiler.

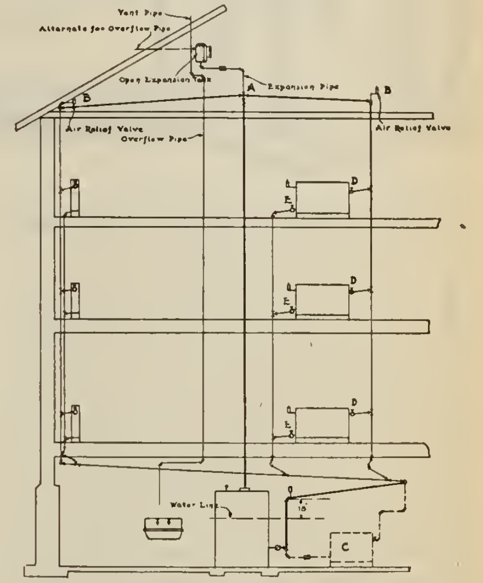

FIG. 6. COMBINED HOT WATER OPEN TANK AND STEAM OVERHEAD SYSTEM.

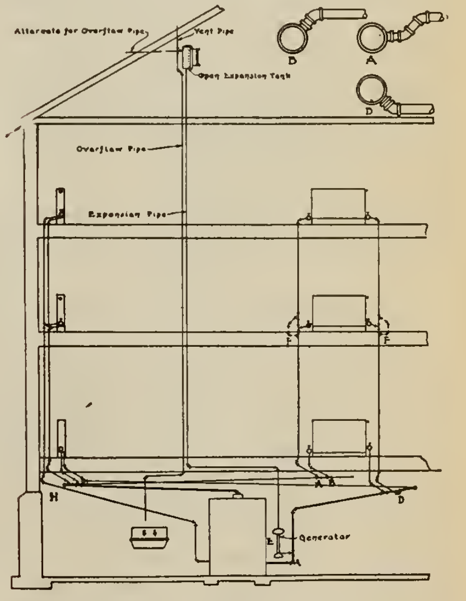

FIG. 7. HOT WATER TWO-PIPE PRESSURE SYSTEM.

Electricity and Hydraulics

ALTERNATING CURRENT DRIVING IN FACTORIES

INFORMATION of value to those who contemplate driving workshops with alternating-current motors was given in a paper read before the Junior Institution of Engineers by C. H. Ayres. As regards the electrical operation of cranes, it was pointed out that three types of motors may be used, direct-current series motors, alternating-current slip-ring motors, and alternating-current squirrel-cage motors. The direct-current series machine is undoubtedly the best for crane driving, but its use is, of course, prohibited where the supply is an alternating one. The next best machine is the slip-ring motor. In the opinion of the author, however, the squirrel-cage machine will, if properly designed, answer the purpose quite well, and offers the advantage that only half the number of trolley wires required by a slipping motor are needed, which arises from the fact that no separate control is necessary for the rotor circuit.

Under the heading of fans, Mr. Ayres said that from the efficiency point of view, the slip-ring motor appears at first sight unfavorably at reduced speeds, but as the output of a fan varies directly as the cube of the speed, it will be found on plotting a curve showing the relation of speed to energy dissipated in the rotor to reduce the speed, that the wastage is not so formidable as it seems. Large machine tools, it is pointed out, occasionally call for speed variation.

Slip Ring Motors Unsuitable

The author considers that in these cases it is usually advisable to employ a squirrel-cage constant-speed motor, and to drive through a countershaft by means of stepped pulleys or else by some form of gradual-change speed gear, such as Reeves' gear. Slip-ring motors with resistance in the rotor circuit are quite unsuitable on account of the poor speed regulation, the speed varying appreciably with every change of torque. Suppose, says the author, in a large lathe or planing machine, that a cut is being taken over a broken surface, such as the underside of a bed-plate, and the controller is set to give half speed with full-load torque, then between the cuts the motor will speed up considerably and the tool will strike the metal on the next portion of the cut at a damaging speed.

Multi-Speed Motors

Where a change-speed countershaft is impracticable, a special multi-speed motor designed for pole-changing may be employed. Suppose two speeds are required, with a ratio of 2 to 1. The stator would be wound with a single winding as in a normal machine, but arranged so that by means of a simple throw-over switch the number of poles is altered and high and low speeds obtained as required. Such motors can be made for the same output at both speeds or to give at the top speed twice or three times the output given at the low speed. As regards cost, however, this machine would naturally be rather expensive. When two speeds are required with a ratio other than 2 to 1, or if four speeds are required, the motor must have two separate stator windings. The majority of multi-speed motors are constructed as squirrel-cage machines, but it is possible to build them with wound rotors.

Accumulator Controlled Pump Drives

These multi-speed motors are ideal for driving hydraulic pumps. The speed changes are made by a controller operated by the travel of the accumulator, and the switching arrangements are considerably cheaper than is the case where direct current motors are used. An interesting example of such an installation is to be found in a large railway works. Three motors are designed to give synchronous speeds of 333, 500 and 1,000 revolutions per minute respectively, with corresponding outputs of 30, 45 and 90 horse-power. Each motor has two stator windings—one for 18 poles and one for 12 poles—and by reversing half the latter winding a 6-pole field is produced.

Under the heading of peak loads come power presses, punching and shearing machines, and other similar machines, which usually do heavy work during only a small portion of the operating cycle. Most machines of this kind are fitted with fly-wheels to overcome the peak load. There are two possibilities which make the fly-wheel of little or no value. Either the capacity of the motor may of itself be insufficient to overcome the peak or the characteristics of the motor such that there is insufficient drop in speed to permit the fly-wheel to give up the energy stored in it, which is apt to throw considerable overload on the motor.

When the greater part of a workshop is driven from line shafting and the machines are provided with fast and loose pulleys, the adoption of alternating current in a factory having its own plant is very convenient and economical, as a squirrel-cage motor can be left permanently connected to the generator and will run up to speed with the generator without taking excessive current. An exciter rather larger than usual is necessary, but the method of starting is, in the opinion of the author, an excellent one. When single-phase current is supplied to a factory the Arno-Ferraris starting system is advocated.

The Generating Plant

The generating plant should consist of two steam turbine-driven alternators, each having a capacity of two-thirds of the aggregate horse-power of the works motor equipment. Normally one of the sets stands idle, but may be used to take up load and help the other set when the works are busy. The turbines, generators and switchboard should be erected on the ground floor and the condenser in the basement. Also, there would be mounted in the basement a high-speed vertical steam engine, connected through a clutch to the air and circulating pumps. These would also be coupled to a three-phase squirrel-cage motor, so that they could be run from the main generator supply. This motor should be of sufficient capacity to drive the pumps at one end of the shaft and the exciter at the other end, the exciter being of sufficient capacity to deal with the lighting when worked by the engine at times when the main sets are shut down. The method of starting up the plant would be as follows:

First the small engine is started with the clutch in, so as to drive the pumps and exciter. The vacuum and exciter volts are so obtained. Next the turbine would be run up to speed, and as voltage and periodicity increase, the main line shaft motors in the works run up to speed simultaneously. Full voltage having been obtained, the pump motor would be switched into circuit and the engine de-clutched and shut down altogether.

Departmental Arrangements

Most machines in pattern shops must stand well into the middle of the space available on account of the size of the pieces of wood to be passed through them, and, further, on account of the fact that the patternmakers' benches are placed round the walls under the direct window light. As the motors, usually ranging from 5 to 25 horse-power, and start light, squirrel-cage machines with star-delta starters may be used. A duct should be placed under the floor, to extend from side to side of the room and open to the atmosphere outside the building. Pipe-ventilated motors drawing air from this duct and discharging the air through gauze into the room are the most suitable for pattern shops.

In the foundry a short length of shafting can be used for driving rumblers, grinders, saws, and the sand blast. This length of shafting may be driven by an open protected-type squirrel-cage motor started with the turbo-generators. As the atmosphere of a foundry is charged with dust, this motor must be cleaned by blowing it with a pair of bellows at least once a week. Cupola blowers should be driven by slip-ring motors, with a regulating resistance in the rotor circuit.

An economical arrangement for machine shops is to have two large main bays separated by a narrower small bay. On the division stanchions between each large bay and the small bay would be a line shaft, making possible the provision of four lines of machines—lathes, capstans, turrets and millers. On the outer side of the main bays would be the large lathes, planers, etc., requiring individual drives. The line shafting would be split up into lengths, requiring motors of from 30 to 50 horse-power. It should be possible to couple or isolate these lengths of shafting by means of clutches. The motors should be close to the shafting and should drive through silent chains running in oil baths. As the motors start up with the turbines only emergency starters will be required, and the handles of these starters should be fixed in the "on" position by means of padlocks. Above the small bay would be a gallery for light machines or for the assembly of detail work.

Various Practical Applications

Blowers and exhausters in the smiths' shop may be driven by high-speed squirrel-cage motors with star-delta starters. Drop hammers, shears, and angle choppers may be driven by high slip squirrel-cage motors and a simple switch; coupling the stator windings directly to the mains will suffice, the torque being ample to accelerate the fly-wheel in reasonable time. Cranes erected over main and small machine bays and also in foundries may be driven by squirrel-cage motors with high-resistance rotors. There should not, however, be any mechanical or soldered contacts in the rotor circuits. All joints must be welded or cast solid. Tramway type reversing controllers may be used for inserting and cutting out resistance in slip-ring rotor circuits, and the longitudinal and cross traverse controllers should be geared together and operated from one handle, so that the movement of the controlling handle is in the direction of the motion required.

The author assumes that the plant is laid out in accordance with the modern plan of receiving goods at one end and shipping them at the other end of the main aisles. Under these conditions there will be in the receiving stores a capstan for wagon haulage, and this capstan will be worked by a two-speed squirrel-cage motor. The controller would consist of two pedals giving high and low speeds and having a spring return arrangement for returning the controller to the "off" position.

Hydraulic lifts, presses, etc., would be supplied by three-throw pumps and an accumulator, and the pumps would be driven by multi-speed motors, as already described. The advantage of the multi-speed motor over the stop-and-start system is that it runs for longer periods at one speed, and thus saves the continual breaking of the circuit. The compressor for supplying compressed air to pneumatic tools and for brazing and soldering must, on account of the heavy torque needed, be driven by a slip-ring motor.

* * *

NEW POWER SUPPLY FOR HYDRO

AS a result of the recent conference held between members of the Federal and Provincial Governments, at Toronto, Ont., Sir Adam Beck, and representatives of the private power companies at the Falls, the Hydro-Electric Commission will in the near future, it is understood, have an additional 32,000 horse-power available to supply the demands of Ontario municipalities.

Although no contracts have been signed yet, and no price agreed upon, it is believed that the extra supply of power will be secured at a lower price than the commission has been paying for the emergency supply from the Electrical Development Co. The power will be supplied by the Canadian Niagara Power Co., which has hitherto been exporting the bulk of its power.

Until the new supply is available, the Hydro-Electric Commission will be unable to furnish any extra power to corporations under contract. At the present time every bit of the hundred thousand horse-power the commission has a right to demand from the Ontario Power Co. under its contract is being used. In fact, the peak load would be some 7,000 horse-power above that mark, but for the arrangement by which municipalities cut down their consumption at certain hours. It is stated that the commission could quite easily dispose of at least 5,000 horse-power at once if it were available. The additional 32,000 h.p. will be obtained from the Canadian Niagara Co.

* * *

RUSSIAN MARKET FOR ELECTRICAL SPECIALTIES

THAT Russia will be one of the most important markets for electrical goods after the war is generally recognized, and if advantage is going to be taken of the hostility to German wares which will prevail for a long period after the war, even if no prohibitive tariff is put in force, steps should be taken to ascertain the particular requirements of this great market. Information relative to the above appears in all the official reports dealing with trade prospects in the territory of our Ally.

The last official to lay stress on the importance of doing something at once is the British Consul at Batoum. He points out that before the war the electrical goods required in the Caucasus were mainly of German origin. There is said to be such a great demand from this district that American and other manufacturers are already giving close attention to the local requirements, but that if the opportunity is not allowed to slip there is no reason why Canadian sources of supply should not also be tapped.

Stress is laid on one or two special points; the need for a close study by British houses of the question of price and terms of payment; also on the importance of being represented by travellers who speak Russian, and who carry Russian price lists with the prices worked out in roubles at the current rate of exchange. These are hints which apply not merely to the Caucasus, but to the whole of the Russian market, and it is hoped they will be taken to heart.

* * *

ELECTRICAL ACTIVITY IN CHINA

CONSIDERABLE activity has been manifest within recent years in the introduction of electric light installations in Chinese towns and cities, as well as the employment of many electrical devices, such as heating and cooking appliances and the use of small dynamos and motors. According to 'Eastern Engineering,' the electric current, especially in Shanghai, being unusually cheap, many small rice mills make use of the municipal electric power for running their machines, and one large flour mill recently erected, which has a present capacity of 1000 barrels of flour per day, employs electricity from the same source. The electrical industry has greatly developed of late among the Chinese, and many of them have become expert electricians.

REFRIGERATION DEPARTMENT

TESTING A REFRIGERATING PLANT WITH AIR

IT is usual to test the high-pressure side of an ammonia compressor plant with 300-lb. air pressure and the evaporating coils and other low-pressure piping with from 100 to 150 lbs, and many engineers seem to belittle the danger of using the ammonia machine as an air compressor, says a writer in the Compressed Air Magazine.

The machine is new and has been turned over by hand to ascertain that the clearance is right. Then it is turned over with steam, or with the motor if it happens to be motor-driven. With the steam drive, the speed can be as slow as desired, but with the motor drive full speed is quickly reached. During this time the compressor does not draw anything from the evaporating side, as an opening is left so that the air is simply pulled in and forced out. Usually, much oil is put into the compressor to lubricate the valves and piston, and some of this lodges in small pockets in the valve cages and the globe valves in the pipes . After everything is ready the unit is turned into an air compressor and the test is begun. A full stream of water is turned through the water jackets, and often a hose is fastened to the discharge line and water allowed to flow over it to remove some of the heat of compression.

The machine should, however, be stopped and allowed to cool after a discharge temperature of not over 250° Fah. is reached, and a thermometer should be inserted in the discharge line at this time, even if it is not left there for future use. The writer believes it would be a good thing to insist on discharge-temperature readings being taken during the test. The erecting engineer should be instructed as to what is a safe temperature and should keep within that limit.

The Lubricating Oil

The oil for lubrication of the new compressor should be furnished by the builders, to avoid the danger of using an inferior lubricant or one with a too low flash temperature. This will mean that the thermometers and the oil will be a part of the erecting engineer's equipment. The lubricant used in many refrigerating plants is good as far as the low-temperature test goes, but when it comes to the question of gasifying under high pressure and temperature, that is another story. The danger of gas ignition and the resultant internal explosion is not any greater in the old system than in the new. The result of such explosion may be more serious in the former, owing to the possibility of ammonia being liberated.

Scale May Start Explosion

In one direction, the writer thinks, a new system is more liable to explosion than an old one. The cylinder surface and the moving valves and piston are not worn to a smooth finish, and the friction is therefore greater. Minute irregularities in these surfaces may easily create friction which may cause a spark that will ignite the gas given up by the oil used for lubrication. In the older compressor this danger is not present. Another producer of sparks may be the particles of scale in the pipes. However well the piping is cleaned, there is some scale, which becomes loosened and may find its way into the cylinder. A small piece of hard scale, getting between the piston and cylinder wall, may cause a spark. Also small particles of scale and grit are sent through the compressor valves, and the pipe work at high speed. These may cause sparks.

Soapy Water Lubricant

There is one positive preventive for such explosions in testing a new plant. Do not use oil for lubrication. Use soap and water or some other material which will not give up a gas when subjected to heat. The amount of moisture thus introduced into the system will do no harm, as nearly all of it will be caught by the oil separator in the discharge line. The proper way, and a way the writer believes should be insisted on, is the use of a special air pump for testing both new and old systems. Such an apparatus can be made to deliver air at a low temperature, and thus do away with the danger of explosion.

When it is necessary to use a motor-driven ammonia compressor for pumping the air test, it should be stopped often and allowed to cool. This is annoying and takes a little more time, but it is safe. An hour or two more or less will not make any difference to the plant, whereas the bursting of a cylinder, receiver, valve or pipe work may delay the starting of the plant a week or many times longer.

* * *

SPRAY NOZZLE RE-COOLING PLANTS

By C. A. Burton

THE ice business does not differ, in a general way, from other businesses, operating in a broad sense, but in detail it does. Ice may be said to be made up of expense without material. It has for base, water, and water from the standpoint of a raw material is a cheap raw product, but to take water and from it make ice, means the addition of coal, oil, more water, ammonia, labor, machinery, horses, wagons, buildings, land, cars, administrative, manufacturing and distribution systems, all calling for high-grade intelligence.

Water to make ice is a fundamental want, but water must be used in an ice plant for other purposes. We find it is necessary, at one stage of the operation, for cooling ammonia condensers. Efficient cooling means low pressure on the compressor piston, and consequent low horse-power on the steam cylinder. Inefficient cooling means high pressure on the compressor piston and increased power required of the steam cylinder—increase of power means increase of coal, and that means increase of expense, and it sometimes means failure to pay profits.

Ammonia Condenser Cooling Water

The necessity of cooling condensers with water, first brought about the use of city supply and if that proved too costly then water was taken from wells, springs, streams, ponds, etc. The waste of water proved that money was thrown away by this method. Ingenuity then came in with the plan of re-cooling the condenser water and re-using it. Devices came into use, more or less good many of them being modifications of the original idea.

The Spray Nozzle system of re-cooling water comprises a set of nozzles arranged in a connected system of pipes, spread out over a poind or basin, or natural lake, if possible, and through these nozzles is pumped the heated water falling off the ammonia condensers. The function of the nozzle is to break up the solid flow of water into a spray or misty drops. The spraying of the water is for the purpose of liberating to the air, the heat contained in the water. As a large body of water parts with its heat slowly, then it is easily seen that the finer the particles of water the faster the heat passes off. To do this is the aim of the spray nozzle.

The spray system as with all other systems is limited to some extent by natural physical conditions, that it to say, we depend on the air conditions for the results of the spray. This applies with equal force to all cooling devices using the air as a medium of heat extraction. We find that air is a good deal like a sponge, it will absorb readily the heat of the water in the spray, if low in humidity, or dry, as it is called, and it hates to, and will not readily absorb, if high in humidity, or wet, as it is called. When dry the air is greedy enough to take out the heat and lower the water temperature below the surrounding air; if, however, it is wet, it will take only a part of the heat out and leave the balance in. It becomes the problem then to so place and arrange the nozzle plant as to care for the quantity of water used, and to be able in time of bad weather conditions to adjust same to the demands of the plant.

Spray Pond Features

The spray ponds are built of concrete, the water in them is generally three feet deep, the nozzles stand only a few inches, six to twelve, above the water, the water is thrown at an angle of about 60° into the air, and the volume of water flowing creates a natural draft which carries the heated vapors away. There is more or less loss, amounting to possibly 10 per cent. under average conditions, which has to be replaced with fresh water.

The plants are built on hillside, roofside, or on the top of buildings, or on level grounds, but it is always desirable to place them where the air has access to them on every side, if possible. The mistake is sometimes made of building these ponds long and narrow, which means that, with the wind at the wrong side, maximum efficiency cannot be obtained. The pressure at the nozzles, does not exceed ten pounds, being usually six, seven, or eight pounds. The sizes of the nozzles range from one-half-inch up to three inches. It is sometimes desirable to have the ponds in two or more parts so that one part or all may be utilized as conditions warrant. As an instance, if water is pumped at 150° with air at 65 per cent, humidity, a single handling would reduce the water to 110°, while with two sets of nozzles, the water could be cooled to 85°. From a paper read before the Western Ice Manufacturers Association.

CANADIAN ELECTRICAL ASSOCIATION ANNUAL

THE annual meeting of the Canadian Electrical Association was held on the s.s. Toronto, Canada Steamship Lines, June 21 and 22, the attendance being large and representative, The arrangement made permitted the Western members to take the boat at Toronto and proceed thence to Prescott, where they were joined by representatives from the East. Business sessions were held on the return trip to Toronto.

In the absence of Colonel D. R. Street, the president, who had just left on active service in command of the 77th Battalion of Ottawa, the chair was taken by D. H. McDougall, vice-president. Correspondence having been read, a report of the Public Policy Committee was submitted by A. A. Dion, superintendent of the Ottawa Electric Co. A full discussion followed.

The secretary then read the report of the Committee on Line Construction and Grounding of Secondaries, which had been submitted by S. B. Hood. Following this, Mr. Maclachlan, inspector of the Electrical Employers' Association, gave a very informing talk on the work being done in connection with the Accident Prevention Committee of the National Electric Light Association and the United States Bureau of Standards.

The report of the Meter Committee, sent in by P. T. Davies, of the Montreal Light, Heat & Power Co., was put before the meeting. It was pointed out by Mr. Davies that he regarded his data as not quite complete. It was decided that the Meter Committee continue its work, withholding formal report until various matters in question had been definitely passed on, and that the committee send in its ultimate findings in not less than three months.

The secretary-treasurer's report, together with the auditor's statement of account, were read. General satisfaction was expressed. The place of the next annual meeting was referred to the incoming managing committee. Officers and committee of management were elected for the ensuing year as follows:

Officers

D. H. McDougall, president, Toronto Electric Light Co.

H. G. Matthews, 1st vice-president, Quebec Railway, Light, Heat & Power Co.

E. A. Dunlop, M.P.P., 2nd vice-president, Pembroke Electric Light Co.

A. Monro Grier, 3rd vice-president, Canadian Niagara Power Co.

T. S. Young, hon. secretary, 347 Adelaide Street W., Toronto.

Alan Sullivan, secretary-treasurer, 910 Excelsior Life Bldg., Toronto.

Managing Committee

W. G. Angus, Dominion Power & Transmission Co., Hamilton.

P. T. Davies, Montreal Light, Heat & Power Co., and Shawinigan Water & Power Co.

M. C. Gilman, Toronto Electric Light Co.

J. S. Gould, Citizens' Electric Co.

H. M. Hopper, the St. John Railway Co.

G. Ratcliffe Hulme, Canada Electric Co.

Geo. Kidd, B. C. Electric Railway Co.

E. L. Milliken, Cape Breton Elec. Co.

J. S. Norris, Montreal Light, Heat & Power Co.

L. W. Pratt, Dominion Power & Transmission Co.

The President, National Electric Light Association.

R. J. Smith, Canadian Electric & Water Power Co.

Jas. B. Woodyatt, Southern Canada Power Co.

The secretary was instructed to write the retiring president, Colonel D. R. Street, Ottawa, and express the sincere regard in which he is held by all members of the Canadian Electrical Association, and the belief that, while the Association was honored in having Colonel Street in the presidential chair, it is still more honored in having its chief officer in command of a Canadian Overseas Battalion. The meeting then adjourned.

Among the companies represented were the following:—Canadian Niagara Power Co.; Toronto Electric Light Co.; Electrical Employers' Association; Canadian Water & Power Co.; Dominion Power & Transmission Co.; Hamilton Cataract Power, Light & Traction Co.; Smith's Falls Electric Co.; Ottawa & Hull Power Co.; Ottawa Electric Co.; Gananoque Electric Co.; London Electric Co.; Pembroke Electric Light Co.; Southern Canada Power Co.; Allis, Chalmers Co.; Standard Underground Cable Co.; the Hull Electric Co.; Citizen's Electric Co.; the Ferranti Electrical Co. of Canada; etc., etc .

Montreal No. 1 C.A.S.E.—At a recent meeting of the Montreal No. 1, Canadian Association of Stationary Engineers, the following officers were elected for the year 1916-17:—Past president, W. G. Forbes; president, W. H. Johnston; vice-president, I. J. Tait; treasurer, R. D. Smith; financial secretary, S. Winter; conductor, W. J. Carmichael; doorkeeper, W. H. Jennings; secretary, A. L. Jones; assistant secretary, A. Hall. A. L. Jones, W. H. Johnston, R. D. Smith, S Winter, H. L. Sackett and J. Carmichatel will represent the lodge at the coming Annual Convention.

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THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air, and Water Power, and to the operation of Refrigerating Machinery.

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Associate Editors,
A. G. WEBSTER J. M. WILSON
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OUR COVER COLOR

THE familiar cover color disappeared with the June issue of The Power House. There is, however, neither savor of summer or compliment about the innovation. Tinted paper stock is at a premium as a result of the war, the import of dyestuffs and coloring matter having reached almost to the absolute zero. To meet these contingencies the adoption of white paper stock became imperative, as our readers will quite appreciate.

C.A.S.E. CONVENTION AND SUPPLIES EXHIBITION

NOT only has an ideal choice been made with regard to a manufacturing centre for this year's C.A.S.E. Convention and Supplies Exhibition, but the housing of the double function in the Montreal Technical School will lend it an air of dignity and importance at once hard to over-estimate, and wholly impossible to surpass or even equal elsewhere. The opportunity to inspect the layout, equipment and student workmanship of the School, and more especially those departments which relate to the sphere of Stationary Steam Engineering, is sufficient in itself to warrant a record-breaking attendance. The knowledge that a Supplies Exhibit is being staged, worthy in a triple sense of the cause, the City of Montreal, and of its Technical School, disposes, however, of any uncertainty in that regard

Every engineer, power and manufacturing plant superintendent, whether a member of the Canadian Association of Stationary Engineers or Exhibitors' Association, or otherwise, should make arrangements to spend a day or two in Montreal during the week of July 24. Munitions manufacture has so engrossed attention during the past twenty months, that the disposition has been to overlook progress and development in other directions. The makers of power plant equipment and accessories have not been idle in the period indicated relative to power product betterment, and through model, illustration, still and operating mechanism, the Exhibition Hall with its half hundred or more booths will bear this out to the full. The dual enterprise at Montreal—if we might so term it, will be found thoroughly expressive of the determination to maintain Canadian power plant efficiency at nothing short of top-notch achievement through unit and operative fitness.

STIMULATING OVERSEAS SERVICE RECRUITING

THERE is every indication that good progress is being made with the scheme of introducing more and more female labor into our factories, workshops and offices. An interesting feature is, of course, the entrance of women into spheres of activity to which in Canada at least they have not so far aspired or have been admitted. By this we mean particularly their employment in the production of munitions of a variety type. In Great Britain many thousand women are employed in shell plants, their work being as diversified as the shells themselves and their component parts, and just as many thousands are engaged in other forms of war-created commodity production.

Supplementary to the movement to increase the numbers and activity scope of women munition workers in our metal-working and kindred plants, and indicative of a proposition that may easily produce highly satisfactory returns, is the action taken quite recently by the Committee on Recruiting of the Montreal Board of Trade. The aim is to have returned soldiers and men who have been rejected fill the places of those operators in our munitions plants who can measure up to the standard of service fitness. Although munitions plants are meantime more directly involved in the scheme of things, it is expected in the end to include the whole wide range of manufacturing enterprise. The idea is, of course, not Government conscription, but a somewhat severe form of compulsion on the part of employers, in order to ensure that men who should be at the front are at least not retained on work that can be done by those who have been in the trenches, or who have shown their desire to serve, and have been rejected.

THE LURE OF EXPORT TRADE

AS might be expected, the lure of export trade is not all-embracing in its appeal. This is not to be wondered at in view of the many considerations and variety circumstances attendant on its successful or even worth-while prosecution. To begin with, many manufacturing concerns—large as well as small, have a domestic clientele which whether in war or peace times monopolizes approximately their production capacity. The net revenue from such sources has been proven not only ample, but without exception, reasonably free from curtailment by losses more or less incidental to all business enterprise. In view of this, they not unnaturally conclude that others less favorably situated or whose product more readily approaches the export requirement, should have all the scope possible.

To participate in export trade calls for abundant financial resources, also equal, if not more close attention to its claims than that deemed necessary for domestic requirement; and, last, but not least, a keen appreciation of the fact that many of the ideas and methods employed in catering to a domestic trade are not only capable of, but require a radical readjustment. In a word, a properly constituted export department is a sine qua non, with every manufacturer who would begin to lay himself out for the successful prosecution of trade beyond the confines of the territory which to him spells "domestic." It is so easy to allow the demands and requirements of the latter to unfavorably influence the former, as to bring about the inevitable result—failure, disgust and regret.

The decision to enter some department of overseas trade should be reached only after due deliberation involving a full accounting of the cost, and with a stolid determination to surmount not only the initiation difficulties but those incidental to subsequent procedure.

The Operators' Point of View

AN ANCIENT SOLUTION OF A MODERN PROBLEM

By A. L. Haas.

IN the desire for easy machining and in the modern tendency to reduce complexity even by neglect of economy in material, factors of considerable importance may be overlooked.

Take for example a high speed vertical engine running at 800 to 1,000 revs. per minute, it is obvious that all material in the moving parts must be of the finest quality. To this end the material for piston and connecting rods and crankshaft is duly tested, yet the curious fact remains that failure of connecting rod bolts is the most common cause of a wreck. The material for these bolts is rarely specified, they are frequently made from bar material and as they are only bolts they get less consideration than they deserve. Often they are made of high carbon steel to reduce weight. The rod material on the other hand, whatever its tensile strength, has to fulfil exacting requirements with regard to extension and reduction of area under test.

Where the Danger Lurks

Granted suitable material, a more pertinent question which is never specified arises in the machine shop. Few turners are aware that sharp square corners at a shoulder cannot be produced except by undercutting the material at this point and so reducing its diameter. In a desire for perfect finish under the head this reduction of cross sectional area is almost invariably found in the bolts mentioned.

There is no need to labor this point to anyone experienced in breaking tensile specimens or to point out the danger of even minute nicking at a change in section. This combination in the case of steel will take tons per square inch away in the tensile result, while if combined with shock stress disaster is cordially invited in practice.

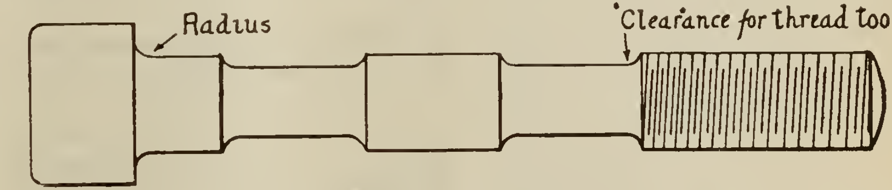
Another point concerns screw-cutting in the lathe. As such bolts are finished all over, and are considered good work it is usual practice to finish them in an engine lathe.

In screwcutting the breakage of all tool points is caused in the withdrawal of the tool at the end of the cuts. A cut thread in the lathe is considered superior to one cut by dies. The sharp nick left at the end of thread has exactly the same effect as an undercut shoulder under the head, it invites breakage. In the case of die cut threads such nicking is less evident since the thread has an effective taper at the end. Working a bar of uniform section must, however, punish the dies and lessen their life.

A Feasible Contention

It is a little curious that a desire for the best possible article made in the most expensive manner should lessen its strength; but such is the contention now advanced, it is thought with due reasons, in the case of uniform diameter bolts. It explains also why black commercial bolts do not fail so unaccountably as a carefully made lathe job.

The remedy for both defects is the same:—The provision of a distinct radius under the head of the bolt and a radius clearance for the thread tool. Using a turret lathe the clearance for thread can be made by the cross slide parting tool suitably shaped. A circular groove, round in shape, is the desired clearance for the thread tool. Such a groove, the depth of thread only, may at first sight look odd but does not weaken the bolt. Where the thread tool usually finishes is a point that the chaser cannot be expected to finish properly.



CORRECT DESIGN OF ROD END BOLT.

The connecting rod bolt illustrated obviates both defects, it has a radius under the head, the brasses being finished in a similar manner; the stem is reduced in diameter to allow the threading tool to pass into clearance when screw-cutting.

Design Established by Age

The design is as old as the proverbial hills, but the modern machine shop is apt to consider its product from its own point of view without regard to other questions. Granted access to a testing machine the matter can easily be put to the proof. The dangers are more obvious in the case of steel than of wrought iron. Taking an analogous case, that of small screw blanks headed cold, if no radius under the head is provided either by design or wear, the enfoliation produced makes heads which almost drop at a touch. If, however, such radius is present, the head may be battered with a hammer and turned over square to its normal position without fracture.

Because a piece is machined and not deformed, the point at issue is overlooked while small size bolts to-day fulfil relatively high missions in the case of automobile and aeroplane engines. The temptation open to make these in automatics without reference to the points raised may lead to fatality.

A recent failure from this cause wrecked a high speed engine driving a 700 k.w. generator and shut down half the product of a factory engaged upon important work. The damage a broken bottom end bolt can cause must be seen before the effect of momentum and high speed can be realized to the full.

Trifles Cause Damage

Such considerable results, however, can accrue from neglect in the machine shop and show that the veriest trifles can overset hundred of dollars worth of careful work. Such minutiae are, however, basic facts for the engineer to consider and they place a large responsibility upon the mechanic.

The matter is of supreme importance wherever steel is employed in the connection indicated and if considerable stress is here laid upon what is a simple matter, it is because in spite of the facts being well known they are repeatedly neglected.

More than one large steamer has limped to port on less than half speed with a cylinder cover gone up through the skylight owing to the cause cited. Numerous failures of high speed generating sets can also be attributed to the same reason. Examination of the spare bolts usually supplied and the type of fracture destitute of any reduction of area or apparent elongation in the material will testify to the facts of the case.

Frequently the material of bolt is described as rotten because of the sudden short character of the break showing no apparent flaw. The entire responsibility is, however, upon the machine shop for the radius under the head, while the draughtsman may take his share in the design of the bolt where the break occurs at the end of the thread. A large factor of safety seems of no value, and many engines now working are a public but unrealized danger owing to the bottom end bolts.

FOOLING THE ELEVATOR

By J. H. R.

HOW many of us have escaped the experience of that qualmish sensation at the sudden starting or stopping of a high-speed electric elevator? Very few; yet it is quite possible to take a trip on one of these perpendicular tramcars without being affected by this disagreeable feeling. The cause of the annoyance is the inability of the various organs of the body to attain the momentum of the elevator in the same period of time. Owing to the delicate construction of the human system, and the elastic manner in which many of the internal organs are supported, it is very difficult for some of them, more especially the stomach, to respond to any rapid or abrupt movement of the outward or more rigid portions of the body. When a person is traveling on a street car, any sudden action of the car will have the tendency to throw the body in the opposite direction, unless by instinct or intention the body is set for the coming movement. However, in the case of the elevator, it would appear that the vertical movement of the body in unison with that of the car offers no opportunity of freeing one from this objectionable sensation; yet it is not only possible to overcome this feeling, but much easier to "fool the elevator" than the tram car.

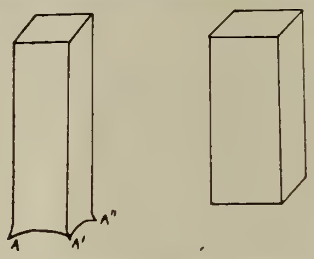
If when stepping upon an elevator, and just previous to the starting or stopping, the entire body is lifted slightly, by raising the heels from the floor, or the knees are bent a little forward, (weak-kneed) sufficient spring is provided to allow for the sudden movement in either direction. By this procedure the internal members of the body will more readily adjust themselves to any abrupt action of the moving elevator.

TO REMOVE A BROKEN STUD

By E. N. J.

SOME men drill a hole in a broken stud and proceed to drive a square drift or piece of steel into the hole, and with a wrench endeavor to twist out the stud; more often than not they fail, as such a proceeding will invariably press the bolt threads in tighter than ever.

One successful method to remove a broken stud is to drill a hole in the latter, then take a square piece of machine steel which will fit the drilled hole snugly, heat one end and hammer out the corners about 1-16 inch full, as at A, A^1, A^{11}, in the illustration. Sharpen these corners with a smooth file and then temper the piece and draw it to a blue heat all over. Next drive this tool into the hole in the stud, and the ends A, etc., will cut four grooves the depth of the hole. Now take a piece of tempered square steel 5-34 inch greater in diameter than the first piece, force it into the grooves and turn out the stud. It will be a stubborn bolt indeed which this will not remove.



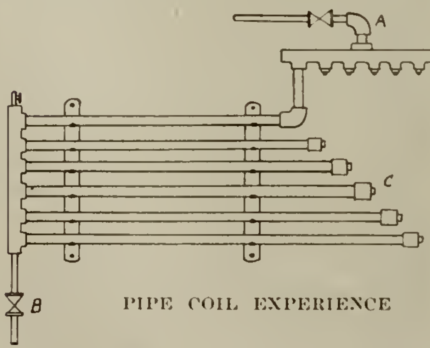
AID TO BROKEN STUD REMOVAL.

Using a left hand tap to remove a right hand bolt has been suggested. also using a left hand drill has been recommended but neither method is in the same class for effectiveness as the foregoing.

CONCERNING ANGLE VALVES AND PIPE COILS

By James E. Noble

SOME engineers advocate the use of angle valves in steam work instead of the usual elbow, nipple, and globe valve. One thing should be impressed upon the user that in accepting this advice he should secure heavy body angle valves as it has been demonstrated years ago that of the two makes of valves the angle is most liable to rupture.



PIPE COIL EXPERIENCE

Again straight way valves are now made at a moderate price, and, altho it may not be possible to keep this type of valve in a steam-tight condition as long as is possible with a valve which can be refaced in position in a few seconds, still its advantages over the globe valve are so great that frequently it is more profitable to use them in many cases even if they will require renewing sooner than would be the case with a globe valve. Again, appearance counts for something! A valve placed on a pipe at some corner looks out of place and unworkmanlike when its proper location is obviously on a straight run pipe elsewhere.

A piece of work can be made to look O'K on paper with angle valves used entirely, but put the same piece of pipework together in practical use and it may not look so good and be as awkward "as a darkey at a chinaman's hop".

I have put in some years of my life as a steamfitter but I found out something last winter. A pipe wall coil, ten feet long, became filled with condensate on account of the drip at B being closed and the steam valve at A being open When it cooled the frost did the rest, breaking five of the right and left cast iron elbows at the turn. The left threads were on the upright pipes. I had no R and L elbows on hand and heat was wanted in a hurry, so taking a chance but expecting failure without air cocks on each pipe, I removed the short uprights and the elbows and plugged the holes at end A and the ends of the pipes at C.

The drip was opened slightly and steam turned on and in about 10 minutes heat had worked through all the pipes and remained hot; the pipes had a slight fall towards end B.

The steam pressure was 80 lbs. gauge. I was taught and always believed that a blank end horizontal pipe coil of this description would not heat up and remain hot, that either return bends or a manifold would have to connect the ends of the pipes, but in this case it did work and has done so nearly all winter and it is still connected as shown for any one interested to see.

SOOT AND ITS REMOVAL FROM HEATING SURFACES

By R. E. C.

EVERY steam engineer is acquainted with the soot evil and with the necessity of keeping it off the heating surfaces in order to maintain maximum boiler efficiency. Before discussing the most efficient means of removing soot accumulation thereon, it is of interest to note a few proven facts regarding soot itself.

Soot is composed of finely divided pure carbon plus certain mineral ingredients, and it occurs in numerous forms, both as to color, which may be grey, brown, red or black, and texture which may be soft and flaky, or on the other hand, more solid in substance and often occurring in formations of very curious nature. From exhaustive and scientific tests it has been established that with one exception, soot is the most efficient non-conductor of heat known to engineers.

To emphasize the heat-resisting power of soot, tests have proven that a clean boiler tube will transmit 140 times as much heat to the water in it or surrounding it as will a tube covered with a one-eighth inch thickness of soot. Such a statement is almost beyond belief, but in view of the thoroughness with which the subject has been analyzed by recognized authorities, its startling truth must be admitted, and with it, the fact that the average user of a boiler is burning an immense quantity of fuel from which he is getting no returns whatever. It is just as true that in numerous plants the matter of soot removal is given but scant consideration, and is frequently done in such a "hit and miss" fashion as to entirely lose sight of the inevitable waste. Power plants operated with the greatest economy are those in which soot accumulation is frequently and thoroughly removed from the boilers. Corrosion of boiler tubes and surfaces is accelerated by deposits of soot either through the electrolytic action or the eating away of the metal by the sulphur constituents that are present to some extent in all soot.

In this day of mechanical soot blowers all of which are easily superior in accomplishment to all hand methods while at the same time much less laborious to operate, there seems little excuse—ignorance not even excepted, for any power plant management, however small the particular installation and irrespective of the boiler type, to continue to allow soot deposits either to contribute to impaired steam raising efficiency or to corroded plates and their attendant explosion risks.

STARTING GAS ENGINES WITH NATURAL GAS

by W. M. Grey

AS there are so many gas wells in this country, the question has very often been put to me, "Why don't you start your gas engines with natural gas?" I have never given any particular reason for any action otherwise, only that I consider "safety first". It is well known that large gas engines are generally first started by compressed air, and, in our case the pressure of the latter is 250 lbs. per sq. in. No doubt with 250 lbs. pressure of natural gas there would be some difficulty in obtaining a mixture which would ignite without back firing and knocking some delicate construction out of commission. It might be practicable however, to start up with the ignition system cut off until the engine has attained sufficient speed, afterwards cutting off the high pressure gas, and putting ignition and proper gas pressure in operation.

I do know of some firms in the West who start up their gas engines with natural gas in place of compressed air, but in these cases it is only necessary to use 40 lbs. pressure. It does look odd for an operator to have to wait and pump up sufficient air to start his engine especially when there is a well one hundred yards away from his engine showing 450 lbs. pressure. If any readers of The Power House are interested in the foregoing, I would like to have them express their opinion through the editorial columns. Personally I incline to the use of compressed air rather than natural gas for starting up gas engines of large size.

HOW TO SUCCEED AS AN ENGINEER

By J. Thorn

HOW to succeed is what every person wishes to know. I remember reading an article on this subject about 25 years ago, and it can be applied to engineers even at the present day although it was not written for them. The article stated that the man desiring success must be a mixture of go-aheadness and holdbackness; he must stick to some of the old ways and yet be alive to all that is new and has a savor of advance. To hold to old methods and practice is to be left behind in the race, while to adopt everything new that presents itself will quickly relegate to failure the unfortunate who attempts it.

To sift out what is good and to reject the worthless is the problem the would-be successful engineer has to solve. We preserve the best methods and in turn are kept alive by the very methods we have preserved and applied. The successful engineer is enabled to succeed because he possesses the faculties of perceiving what is useful and what is worthless. Once this point determined, the rest is easy. The good is to be kept, the worthless discarded, but in knowing what to keep lies the secret of success.

Must the necessary qualities be born in an engineer, or can he be educated to it? Both. To be a successful engineer a man must possess certain characteristics, yet many varieties of men will make good and be successful. To begin with, the would-be successful must be a thinker; he must be able to reason clearly from cause to effect, and instead of sitting down and waiting for something to turn up, he must be able to make the best of things, and work out ways and means of forcing the desired results from the material at hand. He must have an aptness and liking for his work above everything else.

Some engineers are better than others. They obtain better results from the same material than some of their co-laborers. The reason of this is that they are naturally and otherwise better adapted to the work they have to do. In other words they are the "fittest" and will reach the top first. They succeed better than we do because of the use they make of the materials to their hand and of the brains with which they are endowed. We might do as well did we think more and study out better methods for operating our power plants, and be always ready and prepared to grasp offered opportunity. The gateways to advancement were never so numerous as in this year, 1916, with its many low priced, high class engineering journals, and up-to-date text books, many of which can be secured by the man with limited cash on the monthly payment plan. There is no excuse except "laziness" for an engineer being ignorant to-day.

ERA OF ROTARY TYPE MACHINES

PERHAPS the most marked feature in the history of power production has been the replacing of reciprocating machinery by that of rotary type. The steam turbine has invaded and captured a considerable portion of the fields of usefulness of the reciprocating steam engine. The centrifugal water-pump has replaced the reciprocating pump; rotary condenser auxiliaries are rapidly superseding reciprocating plant, and rotary air blowers and compressors have entered into successful contest with reciprocating compressors. The principal factors which have decided the issue in favor of the rotary plant are: small space, excellent balance and low first cost and maintenance. In the case of the steam turbine there is the important additional advantage of using steam which otherwise would be wasted.

Oxy-Acetylene Welded Pipe.—A series of experiments has been undertaken at the University of Kansas, under the supervision of F. H. Sibley, to determine the strength of oxy-acetylene welded pipe connections as compared with screwed connections of equal size, and with the original pipe material. The results show that the strength of the welded connections ranges from 13 to 71 per cent. more than that of the malleable iron screwed connections, which are taken as 100. As regards the total cost of welded and screwed connections, the welded is the cheaper in every case. The cost of the fittings is the principal item of expense in the screwed connections.

Operators' Instruction Course

THE STEAM BOILER—VII.

FIRING a boiler with green walls invariably cracks the setting, hence it is absolutely necessary to dry out the brickwork properly. If circumstances permit, it is advisable as soon as stack connections are made, to block open the damper and ash-pit doors, so that circulation of air will aid in drying the brickwork. The next step is to fill the boiler with water and put in a light fire of shavings, which may gradually be increased by using some wood, continuing until the walls are thoroughly dried inside and out. This will require several days, but by close observation the walls can be dried out without cracking.

When steam is available an excellent method of drying the brickwork is to connect temporarily a small steam supply pipe to the new boiler, and to attach a trap or other drainage apparatus to the blow-off pipe. The new boiler when filled with steam will then act as a large radiator, and will heat the air around it, hence if ash-pit doors and damper be left open there will be a steady current of warm air passing through the setting, and the brickwork will be gradually and effectively dried out. The steam supply should be very small at first, and be increased as the drying-out proceeds.

Cutting Boiler into Steam Main

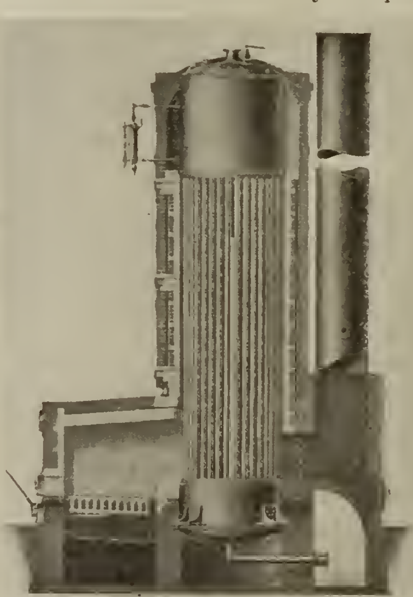
Under no circumstances whatever should a boiler be "cut in" with other boilers unless the pressure within it is identical with that in the main. Before opening the boiler stop valve or the header valve, be sure that there is no water in the length of pipe between these two valves. Steam valves should always be opened or closed very slowly, and the valves should first be eased from their seats slightly for some moments to permit a circulation to become established before the valves are fully opened. When the boiler is in service, observe the following carefully and at regular intervals make an inspection so you will know that everything is right.

Steam Gauges.—When pressure is off these should stand at zero, and when safety valve blows off, the gauge should indicate the same pressure for which the valve was set to pop. If it does not, one is wrong, and the gauge should at once be compared with another of known accuracy, and any error be rectified.

Safety Valves.—These are useless if allowed to become stuck on their seats. To prevent this, cause the valves to pop once on every shift.

Water Level—Never fire a boiler without first ascertaining that it contains the necessary quantity of water. When operating, never depend on gauge glass, or water alarms alone, but try the gauge cocks.

Gauge Cocks, Water Gauges, and passages to guage must be kept clean, and should be blown out frequently. Formation of colored rings on the glass, due to oil or other deposits, is misleading and should be obviated by frequent cleaning. Automatic water gauges of all types and all other automatic appliances need frequent inspection .



WICKES VERTICAL WATER-TUBE HAND-FIRED STEAM BOILER.

Blow-Off Valves must be kept tight, and should be known to be tight. Every blow-off pipe should be so arranged that a leak can be seen. This can be arranged by placing in the pipe just beyond the blow-off valve, a tee with a 1 in. outlet to which a gate valve is attached; this valve should be left open except when blowing-off is in progress, so that it will act as a tell-tale in case the blow-off is leaking. Where boiler water deposits material that is liable to cut the blow-off valve and cause leaks, a gate or asbestos packed plug cock should be placed between boiler and regular blow-off, so it can be closed and permit the blow-off valve to be cleaned without shutting down the boiler.

Firing—The method of firing coal to be adopted will depend upon the kind of coal used, and the most efficient method of firing be determined by close observation and experiment. The draft should be regulated to the least amount necessary to maintain the desired rate of combustion. When burning wood, carry as thick a fire as the draft will allow; the fresh wood on top tends to force down the partly burned wood thus covering the grate with a bed of fuel and reducing the air excess. When burning oil, see that the flame is white, not red, and free of sparks which indicate incomplete combustion. The air supply should be regulated to a point where further diminution of it will cause smoke to appear in the stack. Avoid squirting unatomized oil on the tubes of water-tube boilers, as each spot where it touches is liable to develop a blister.

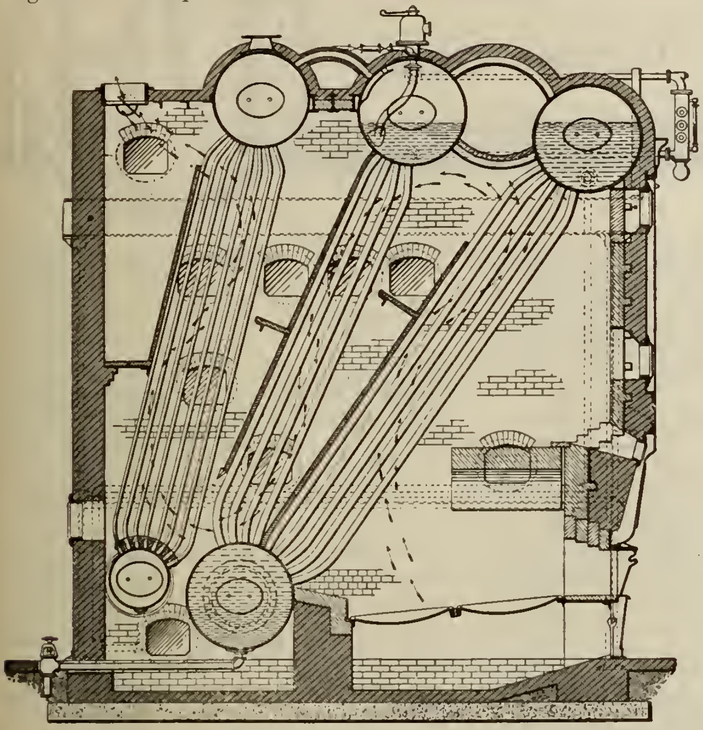
Foaming—If caused by excessive demand for steam, checking the outflow of steam will usually stop it. If caused by excess of dirt due to concentration, blowing down and pumping in clean water will usually stop it. In case of violent foaming, check the draft and fires.

Blowing Off—When feed water is salty or muddy, blow off a portion at as frequent intervals as the conditions demand. Empty the boiler every week or two and fill up afresh, but never empty the boiler while brickwork is hot, and never feed cold water into a hot boiler.

Low Water—Immediately cover fire with ashes or earth, preferably wet; in default of anything else handy use fresh coal; the important point is to check the heat as quickly as possible. Draw the fire as soon as it can be done without increasing the heat. Do not turn on the feed, lift safety valve, start or stop engine, until boiler is cooled down. Before firing the boiler again, put on the cold water test, locate any leaks, and stop them.

Cleaning—To avoid waste of fuel and deterioration of the boiler, keep it clean inside and out.

Air Leaks—All air that enters boiler or breeching except by passing through the fire, causes losses which are often large and unsuspected. Carefully test for leaks around cleaning door frames, blow-off pipes, dampers, breeching connections, etc., and carefully plug each with asbestos rope or cement.



SECTIONAL SIDE ELEVATION OF STIRLING WATER-TUBE BOILER WITH SUPERHEATER IN REAR PASS.

Steam or Water Leaks should be stopped without delay, and extra precaution should be taken to exclude water from those portions of the boiler covered by brickwork, otherwise unsuspected corrosion may occur. Leaks in steam pipes over the boilers should be located and stopped.

Internal Corrosion of Boiler—This is caused by some harmful agent in the water, and the matter should at once be referred to some competent chemist experienced in investigating boiler feed water.

Unused Boiler—If a boiler remains idle it will deteriorate much faster than when in use unless it receives proper attention as soon as its use is discontinued, hence the following instructions must be carefully observed. Before emptying the boiler feed in several gallons of crude oil so that when the blow-off is opened the oil will form a light covering over the whole inside surfaces. Before the boiler is started again, remove this oil with soda-ash as already directed. Dry the boiler thoroughly when emptied out. If the boiler cannot be emptied, fill it quite full of water, to which has been added a quantity of soda-ash, then boil off the air and close the boiler air-tight. In water-tube boilers, remove the baffle tiles, thoroughly sweep off all accumulations of ashes and soot with a wire brush, and give all tube and drum surfaces a coat of boiled linseed oil. Smear all brass or finished work with vaseline slush, or a mixture of white lead and tallow. Cover the stack tops with a water-tight hood, and see that no water can reach the boiler through breechings, openings in roof, or other sources.

Blisters and Cracks.—These are liable to occur in the best material. When the first indication appears there must be no delay in having it carefully examined and properly cared for.

Feed Pump or Injector.—These should be kept in perfect order, and be of ample size. No make of pump can be expected to be continuously reliable without regular and careful attention. It is always safer to have two means of feeding a boiler. Check-valves and self-acting feed valves should be frequently examined, cleaned, and overhauled.

To secure satisfactory service from stationary steam boilers, it is absolutely essential that the setting be constructed with the utmost care and of the best material.

Testing Steam Boilers

The object of testing a steam boiler is to determine the quantity and quality of steam it will supply continuously and regularly under specified conditions, the amount of fuel required to produce that amount of steam, and sometimes sundry other facts. In order to ascertain these things by observation it is necessary to exercise great care and skill, and to employ the most perfect apparatus, or errors will creep in sufficient to vitiate the test, and render it of no value, if not actually misleading. The principal points to be ascertained and noted in a boiler test are:

1—The type and dimensions of the boiler, including the area of heating surface, steam and water space, area of water surface, and draught area through or between tubes or flues.

2.—The kind and size of furnace; area of grate with proportion of air spaces therein, height and size of chimney, length and area of flues.

3.—Kind and quality of fuel and amount of ash and water therein. The latter is a more important item than is generally understood, as it not only adds to the weight without adding to the value of the fuel, but the heat taken to evaporate, and send the steam up a chimney in a highly superheated condition, adds to the unobserved waste.

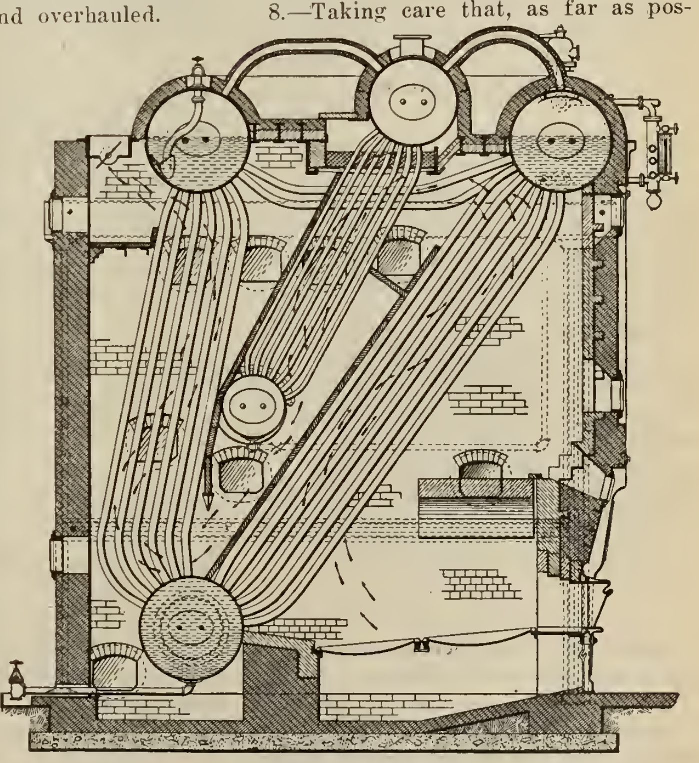
4—Temperatures of external air, of fire-room, of chimney gases, of fuel, water and of steam.

5—Pressures of the steam, of barometer, and of draught in chimney.

6—Weights of feed water, of fuel, and of ashes. Water meters are not reliable as an accurate measure of feed water. Tanks are preferble.

7—The analysis of flue gases to determine the relative percentages of carbonic acid, carbonmonoxide, and oxygen. This enables the perfection of the combustion to be determined, and if too much or too little air is being admitted.

8.—Taking care that, as far as possible, the observed conditions are the same at the time of starting and of stopping the test.



SECTIONAL SIDE ELEVATION OF STIRLING BOILER WITH SUPERHEATER IN MIDDLE PASS.

9—The quality of the steam, whether wet, dry or superheated.

Question and Answer Series

Question.—What is the capacity, in cubic inches, of the British Imperial gallon; also that of the U. S. gallon?

Answer.—The standard unit measure of capacity for the British Imperial gallon, for either liquid or dry material, is that of ten Imperial standard pounds of distilled water having a temperature of 62 degrees, weighed in air of the same temperature, and with the barometer at 30 inches; the water to be weighed with brass weights. While the weight of a cubic foot of water is usually considered to be approximately 62½ pounds, several authorities give the weight as being 62.355 pounds. From this the Imperial gallon will contain $\frac{1728\times10}{62.355}=277.123$ cubic inches. However, the value generally used is that of 277.274, which for all ordinary purposes is sufficiently accurate.

The U. S. gallon weighs 8.345 pounds, and a cubic foot of water at 39.2 degrees F. is 62.425 pounds. The contents of the gallon will, therefore, be $\frac{1728\times8.345}{62.425}$ $=231$ cubic inches.

* * *

Question.—What should the ballast of an accumulator weigh to maintain a pressure of 350 tons on a 24-inch piston, and what would the pressure be per square inch?

Answer.—To exert a pressure of 350 tons at the press, it is obvious that the source of power—or the weight of the accumulator—must equal that at the press. To calculate the pressure per square inch, the total pressure must be divided by the area of the piston, thus:

$$\frac{350\times2000}{24\times24\times.7854}=1538$$

pounds per square inch.

* * *

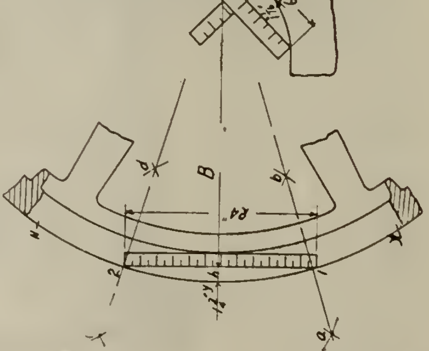
Question.—What is the method used when squaring a mixed number, such as 9¾?

Answer.—The squaring of mixed numbers may be accomplished in several ways. The method generally adopted is to multiply the number by itself, as is done in the case of whole numbers; by the fractional method you first convert the number to an improper fraction. To do this, multiply the whole number of the fraction by the denominator and add on the numerator; the number thus obtained will be the numerator of the desired fraction, and of the same value as the mixed number, thus: $(9\times4)+3=39$, and 39 over 4 will give $\frac{39}{4}$, and $\frac{39}{4}\times\frac{39}{4}$ $=95\ 1/16$. The best method, however, is to convert the mixed number to a decimal, and proceed as in whole numbers, thus: 9¾ equals 9.75, and this multiplied by itself gives 95.0625. Another method may be applied, that of using the formula $(a+b)^2$, which is resolved into $a^2+2ab+b^2$, where (a)= the whole number, and (b)=the fraction, thus $9\times9=81.2\times9\times\frac{3}{4}=13\frac{1}{2}$, $\frac{3}{4}\times\frac{3}{4}=9/16$. total 95 1/16.

No set rule can be recommended for the squaring of mixed numbers, as the latter may require to be solved by different methods. The nature of the question, however, will generally indicate the best way of arriving at a solution.

* * *

Question.—When the centre of an arc is not available, as in a large fillet or broken wheel, how can the radius of arc or diameter of wheel be determined?



Answer.—A good rule to calculate the diameter of a fillet when only a section of the circumference is available is to divide the sum of the square of the height and the square of half the chord by the height. For example, in the sketch of the fillet shown at A a six-inch rule is laid across the fillet and the height of the opening is found to be 1 1-16 inches. From the above rule the diameter would be

$$\frac{3^2+1.0625^2}{1.0625}=\frac{10.129}{1.0625}=$$

9.533 inches.

The same rule applied to the flywheel section shown at B would be

$$\frac{12^2+1.75^2}{1.75}=\frac{147.06}{1.75}=84.04\text{ inches.}$$

The centre of the arc can be determined graphically by selecting three points on the circumference, as x, y, z. Bisecting these distances as shown, the intersection of the produced lines will be the centre of the arc or circle of the original wheel.

* * *

Question.—What is specific gravity, and how can it be used to calculate the weight of different substances?

Answer.—The specific gravity of a body is the ratio between its weight and the weight of a like volume of distilled water at a temperature of 39.2 deg. F. To find the weight of any liquid or solid, when its specific gravity is known, multiply the specific gravity by 62.5, the weight in pounds of a cubic foot of water. For example, if the specific gravity of cast iron is known to be 7.21, the weight of a cubic foot would be $7.21\times62.5=450.6$ pounds; or weight per cu. inch would be $450.6\div1728=.26$ pounds or 4.16 ounces.

* * *

Question.—What are the design, constructional and operation features peculiar to the Una-flow, and to what extent is it being installed as a prime mover?

Answer.—Patents for the first engine embodying the principle of the flow of steam in but one direction through the cylinder were taken out in England as early as 1885, but the first successful engine was not built until 1909, when J. Stumpf, a German inventor, introduced a Una-flow engine at Brunn, Austria. The engine met with success from the first and at the end of July, 1911, over 500,000 horsepower was being developed in Una-flow engines in Europe. The use of this engine has spread to practically all lines of work and to-day the Una-flow type is being used on locomotives, in marine service and for driving rolling mills. The development, however, has been closely confined to Europe, and only until the past few years have American manufacturers undertaken the construction of these engines. The cylinder of the Una-flow engine differs from that of other steam engines in that the exhaust ports are at the center of the cylinder. Exhaust takes place when the piston is at approximately nine-tenths of its stroke. The live steam is admitted through poppet valves at the ends of the cylinder, and the heads are so designed that the steam before entering the cylinder passes through chambers in the heads, thereby jacketing them. This arrangement of the flow of steam reduces the losses usually caused by initial condensation, and it is to this feature that the engine owes its high efficiency. The Una-flow engine, due to its capacity for wide temperature ranges, is able to carry expansion from boiler pressure down to condenser pressure without the necessity of compounding but with the same steam economy of a compound engine. The mechanical efficiency varies from 85 to 92 per cent. The principal advantage, however, lies in the fact that a great overload may be carried with only a scarcely noticeable increase in steam consumption.

* * *

Question.—What is the function of the air vessel as fitted on the discharge line of boiler feed and various other type pumps?

Answer.—An air vessel in its upper portion maintains a cushion of air which absorbs all shock or knock from the operation of the pumps, and prevents same being communicated to the solid mass of water in the piping.

* * *

Question.—What do we understand by an expansion joint, and under what circumstances are they necessary? What attention do they require, and of what materials should the working surfaces consist?

Answer.—Expansion joints are used when there are no long easy bends in the piping to take up expansion when under steam. They are generally of the ordinary stuffing box form, i.e., a stuffing box on one pipe end, into which the other pipe slides. Packing is put in, and the gland screwed up in the usual way to prevent steam escaping. They require attention from time to time, so that the gland does not get set fast or the packing be burnt away. The working surfaces in the box and gland should be brass bushed in the ordinary way.

* * *

Question.—To find the minimum lift of a safety valve in order to give an area of escape for steam equal to the area of the valve.

Answer.—Lift required equals area of valve divided by its circumference, which, in other words, is the diameter of the valve divided by 4. Arranged as a formula, where L represents the lift required, and D the valve diameter—both in inches, we get $L = \frac{.7854D^2}{3.1416D} = \frac{D}{4}$. Assuming a valve diameter of 4 inches, the required lift by formula would be one inch, found as follows:—

$$L = \frac{.7854 \times 16}{3.1416 \times 4} = \frac{12.5664}{12.5664} = 1 \text{ inch.}$$

* * *

Question.—To find the cubic feet of water blown out per minute through a rivet or other hole in a boiler, the pressure in the latter and the diameter of the hole being known.

Answer.—Multiply the square root of the pressure by 2½ times the hole diameter squared. Thus, $2.5d^2\sqrt{P}$ = cubic ft. of water blown out per minute. With boiler pressure of 100 pounds per sq. inch and a hole of 1½ inch in diameter, the water blown out per minute would equal $2.5 \times 1.5^2\sqrt{100} = 2.5 \times 2.25 \times 10 = 56.25$ cub. ft.

* * *

Question.—On what does the strength of the furnace tube in an internally fired boiler depend to sustain satisfactorily such pressure as it may be subjected to, irrespective of the quality of the material?

Answer.—Length, diameter, and plate thickness squared are combination factors. The greater the length, the weaker the tube; the larger the diameter, the tube is correspondingly weaker, and the thicker the plate, the stronger the tube in proportion to the square of the thickness.

* * *

Question.—Is any special apparatus required or procedure involved in drilling holes through glass? I am led to believe so.

Answer.—Drilling holes in glass is more or less a simple matter, a good steel drill moistened with diluted sulphuric acid, or with turpentine in which a little camphor has been dissolved, ensuring a satisfactory job.

* * *

Question. — What tests other than those of color and odor can be applied to determine the quality of hydro carbon lubricating oils.

Answer.—Color and odor tests are generally sufficient for men with large experience to arrive at a decision. Other tests, and those which will be more convincing perhaps to the uninitiated are as follows:—(1)—The oil should not solidify at a temperature exceeding 32 degs. Fah. (2)—It should show no percentage of evaporation due to exposure. (3)—It should have no odor except that of petroleum. (4)—Its color should be only slightly florescent and perfectly clear. (5)—It should not saponify if treated with an alkali. (6)—It should have a flash point of not less than 350 degs. Fah.

* * *

Question.—What is understood by the phrase "mean effective pressure," and how is it determined?

Answer.—Mean effective pressure is the average pressure acting on the piston of a steam engine during its entire stroke and causing motion. The amount of it is determined in a practical manner from the indicator diagram, the procedure being as follows:—Divide the diagram longitudinally into 10 equal spaces, then measure the width between each of the spaces by the diagram scale, add all the measurements together and divide the total by ten. The answer will be the mean effective pressure. The latter can be calculated theoretically, but the result is only approximate, it being difficult to allow satisfactorily for cylinder clearance, losses by radiation, condensation and friction. The indicator diagram method is easily the more accurate.

* * *

Question.—We speak of so many "inches of vacuum" in the condenser; what then is meant by say 20 inches of vacuum, and what does that tell us regarding absolute pressure of contained vapor.

Answer.—Vacuum is usually measured by inches height of a column of mercury, two inches of mercury equalling one pound pressure per sq. inch; thus 20 inches of mercury means 10 pounds pressure per sq. inch. If we find 10 lbs. or 20 inches registered on the vacuum gauge, it shows that there is a vacuum equal to 10 pounds per sq. inch acting at the exhaust side of the engine piston, or from absolute zero, a pressure of vapor exists in the condenser equal to the difference between the barometer and the vacuum gauge. Thus, if the former stand at 15 lbs., the pressure of vapor in the condenser will be 15 minus 10 = 5 lbs.

* * *

Question. — What is the maximum pressure usually found in the compressors of CO_2 refrigerating machines.

Answer. — The maximum pressure varies with the temperature of the condenser water. It runs from 850 lbs., in temperate zones to over 1000 lbs. per sq. inch in hot climates, the variation being due to the fact that carbonic acid and gas is more difficult to liquefy than is ammonia.

Steam Power Plant Auxiliaries

FEED WATER HEATERS—II.

In the previous article of this series, dealing with feed water heaters, an outline was given of the principal types of heaters in general use, as also the principles of construction which govern their adaptability to varying circumstances. Without in any way detracting from the merits of the closed type and its suitability under certain conditions, the superior economy of the open type under the majority of ordinary conditions has led to its widespread adoption, since in the open heater the steam comes into actual direct contact with the water to be heated, so that the transmission of heat is immediate, allowing the water to be brought up to the full temperature of the steam. The spraying of the water through the steam bath also has the effect of driving off air and other gases held in solution, thereby reducing corrosion in the piping and boilers, and facilitating the precipitation of scale-forming substances.

Cochrane Open Feed-Water Heater.

Two principal types of Cochrane heaters are made, being built and marketed by Canadian Allis-Chalmers, Toronto. One of these types exhausts freely to the atmosphere, being known as open feed-water heaters, while the other type is for use with engines that furnish exhaust steam for heating or drying systems, and is known as the Cochrane feed-water heater and receiver.

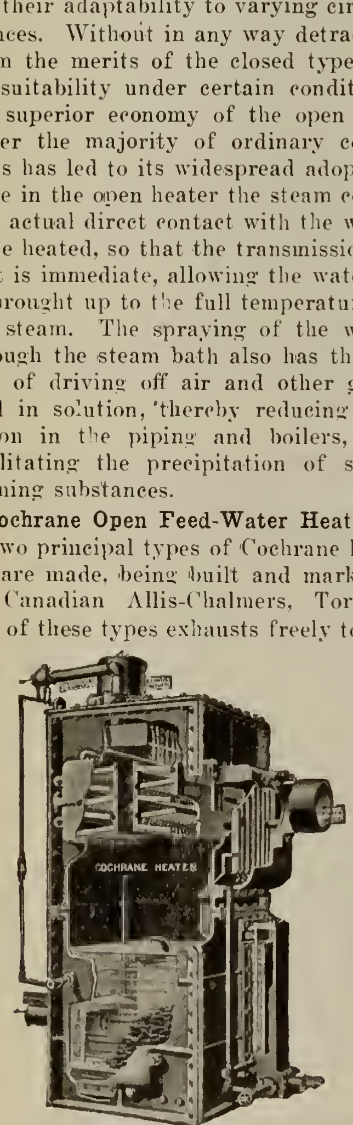


FIG. 5. COCHRANE OPEN FEED WATER HEATER FOR ENGINES EXHAUSTING INTO ATMOSPHERE.

As the exhaust steam is condensed and becomes a part of the feed water, it is vitally important, as already pointed out, that an open heater be protected by an efficient oil separator. In these heaters (see Figs. 5 and 6) the separator is attached to, and forms part of the heater, and consists of a vertical baffle placed in the path of the entering steam, to intercept the incoming oil and water carried by the exhaust, and provided with ribs to prevent the current of steam scrubbing the oil off again in its passage around the baffle. The water and oil separated from the incoming steam drain into a trap or water seal. In heaters intended for use in connection with engines exhausting freely to atmosphere, that is, without back pressure, this trap takes the form of a plain water seal of sufficient height to prevent the escape of exhaust steam to the waste connection. The same water seal communicates with an overflow weir within the body of the heater. The purpose of this weir is two-fold—first, to permit of periodically skimming the surface of the water in the heater, and second, to make impossible any rise of water level above a fixed point, thereby protecting the engines against water being drawn back through the exhaust pipe.

Cochrane heaters and receivers are distinguished from the heater just described in that the plain water seal is replaced by a float trap. Where this type of heater is installed—that is, where the engines, pumps, etc., exhaust against back pressure, steam is generally employed for other purposes, as in radiators, heating and drying coils, steam jackets, calendering rolls, low pressure turbines, absorption ice machines, etc., and in order that such steam after condensation may be returned to the feed-water heater and used for boiler feeding, an oil separator should be installed in the exhaust line, together with a trap for draining it.

In the Cochrane steam-stack and cut-out valve heater and receiver the separator on the heater is made of sufficient capacity to purify all the exhaust steam, including that passing to the heating system, thus saving the expense, complication and space incidental to an independent separator in a by-pass. To permit of cutting the body of the heater out of circuit for inspection or cleaning while the heating system is in operation, valves are incorporated in the design between the separator and the heater, and between the trap which drains the separator and the heater overflow. When these valves are closed and the operating handle removed, the heater may be opened without fear of steam being turned in. The valve in the separator is held to its seat by springs, which is a valuable safety feature, since it prevents accumulation of pressure in the heater body when the latter is cut off from the main circuit, as by the discharge of live steam traps or other high pressure steam direct into the heater.

Cold Water Admission

The admission of cold water to Cochrane heaters is controlled by a float, which operates a regulating valve in the make-up supply connection. The heater thus takes the place of an automatic make-up water regulator. The cold water is delivered into a trough in the top of the heater, from which it overflows upon serrated trays. Condensed returns may be delivered either into this trough or into a separate returns trough, depending upon their temperature—that is, whether or not they require to be heated. Due to the automatic control of the make-up water, the heater performs the duties of an automatic make-up water regulator, and by serving as a receptacle for all drips, condensate, etc., suitable for boiler feeding, it takes the place of a hot well or returns tank.

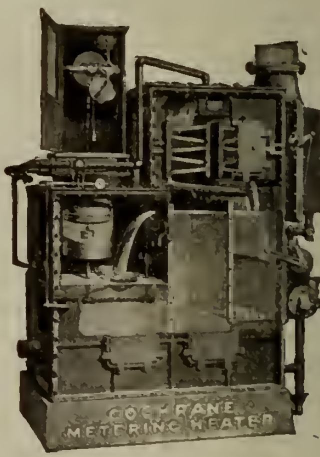


FIG. 6. COCHRANE METERING HEATER.

As all feed water supplies are brought together before being finally pumped into the boiler, an opportunity is offered for their measurement, and a recent modification of the Cochrane heater, known as the Cochrane Metering Heater, provides for this, by the incorporation of a V-notch weir and a suitable approach passage and outflow chamber for the latter (see Fig. 6). This weir is incorporated within the heater structure, under the same pressure that exists in the latter, thus avoiding any possibility of complication due to rapid fluctuations in steam pressure, such as frequently occur where the exhaust is intermittent or the supply of cold water is variable.

By accurately measuring the feed water, the metering heater makes it possible to determine the evaporation, also to ascertain the values of different grades of coal, different methods of firing, the effects of cleaning soot and scale off tubes, and hence the frequency with which these operations should be performed, besides benefits form stopping up air leaks in the boiler setting, changes in the grates or methods of firing, etc. Once the most favorable conditions and the maximum evaporation which they will give have been ascertained, the metering heater serves to show by its record whether these favorable results are being realized in regular operation.

Water Softening Apparatus

In a preceding paragraph the fact is mentioned that the heating of the water by spraying through a steam bath accomplishes more or less purification, due to the escape of air and other gases. Advantage has been taken of this, and of the further fact that chemical reactions are much more rapid and complete in hot water than in cold water, in the Sorge-Cochrane hot process water softener, which in addition to a Cochrane open heater, also provides for the accurate treating of the water with softening reagents, and for the subsequent removal of the precipitates before the water passes to the boiler. The use of both heat and the proper chemical treatment makes possible a great advance in water softening practice—that is, whereas with the cold process a reduction to three grains per gallon of scale-forming substances was the best to be guaranteed, with the hot process it is frequently possible to reduce the scale-forming solids to half this amount, and in some cases to less than one grain per gallon.

All forms of Cochrane heaters, with the exception of the Sorge-Cochrane hot process softener just described, are constructed throughout of heavy cast iron plates, which because of their thickness and resistance to corrosion are more durable than steel plate. The heater body may be of the rectangular form, or where large capacity is required and low headroom, the horizontal cylindrical type of heater is provided. Where a very large water storage capacity is required, as in the softeners, and also in special heaters designed for supplying and storing hot water for industrial purposes, the storage chamber may be of either steel plate or cast iron, depending upon local conditions.

Massillon Open Heater

This heater is illustrated in Fig. 7, which shows the principal features of construction, such as accessible cast iron trays, non-stick plug steam cut-out, large oil separator, ample water seal, upward filtration through large filter bed, absence of internal holding bolts, and quick opening pump suction by-pass.

It is built by the Canadian Griscom-Russell Co., Montreal, and consists of a cylindrical cast iron shell containing all the various devices necessary for purifying, controlling and heating boiler feed water. The metal used for the shell trays and other parts in contact with the raw-feed water is cast iron, on account of its durability and resistance to corrosion. A generous area of surface for receiving deposited scale and mud is provided by a series of trays of cast iron of simple and strong form. These trays may be readily slid in and out of place, being designed so that even the presence of large quantities of scale cannot interfere with easy removal for cleaning as often as necessary. In the upper portion of the heater shell is a large opening closed by a convenient door, giving ready access to the trays and to the interior of the heater.

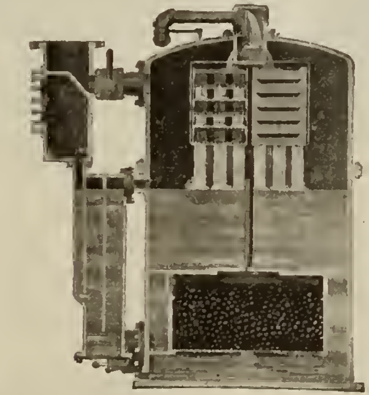


FIG. 7. SECTIONAL VIEW OF MASSILLON OPEN FEED-WATER HEATER.

The space immediately below the trays is utilized as storage for feed-water, previously heated and cleared of all solid matter in its passage over the trays. The level of water in the storage space is maintained by a float, connected to the feed-water inlet valve. The supply of make-up feed water is thus regulated automatically by the feed pump. An overflow opening with skimming edge is provided to remove floating material and scum.

Filter Arrangement

The feed-water storage is divided by a horizontal cast iron plate, through which a passage leads the water to a settling chamber at the bottom of the heater. From the settling chamber the water filters upward through a filtering chamber containing coke supported on a perforated plate. Above the filter the water passes into a storage space from which the feed pump draws.

The positive cut-out valve previously mentioned permits the heating steam being shut off from the heater, and allows access to the interior for cleaning without shutting down the plant. This valve is positively operated, and is similar in design to boiler blow-down plug cocks.

Oil Separator

A baffle plate type oil separator is employed, through which all the exhaust steam is passed and effectively cleared of oil and drip water. From the separator a suitable opening automatically admits the required quantity of steam to the heater. A vertical opening on top of the separator provides for an open-air exhaust pipe connection, through which the excess of exhaust steam can flow to the atmosphere without passing through the heater.

The upward flow filter, as adopted in this case, is an important feature. It is evident that mud and suspended substances in the feed-water tend to deposit themselves on the floor of the large settling chamber below the filter. Any finer particles carried upward by the current of water are intercepted by the lower layers of the coke in the filter, and cannot easily penetrate far into the body of coke. For this reason the coke filter can be readily cleared of sediment by merely drawing off the water from the bottom of the heater. The reversed current set up by the water contained in the chamber above the coke tends to wash the filters clear of all impurities.

The filter is easily reached through a large door provided in the side of the heater shell. By swinging back this door on its hinged bolts, the coke can be easily shoveled out of the heater and all parts of the filtering chamber reached.

Operating Features

A by-pass is provided in case of emergency, by which through the simple opening of the valve, the entire body of water in the heater can be made instantly available for feeding the boiler without first passing through the filter.

A large water seal is provided to permit carrying one-half pound back pressure on the heater without the added expense of a trap. For higher pressures the heater can be equipped with a special overflow trap operating independently of variations in the exhaust back pressure. This trap is float-actuated and operates to open the overflow whenever an excess of water running over the skimming dam reaches the trap. The drain from the oil separator is connected with the same trap.

Progress in New Equipment

BEYER BAROMETRIC CONDENSER

THE Ingersoll-Rand Co., New York City, is placing on the market complete steam condensing plants for every service condition. This equipment includes the Beyer barometric condenser, for which the company has secured the patent rights, Imperial duplex and Ingersoll-Rogler straight line, reciprocating, dry vacuum pumps, and, where required, Cameron simplex and centrifugal pumps.

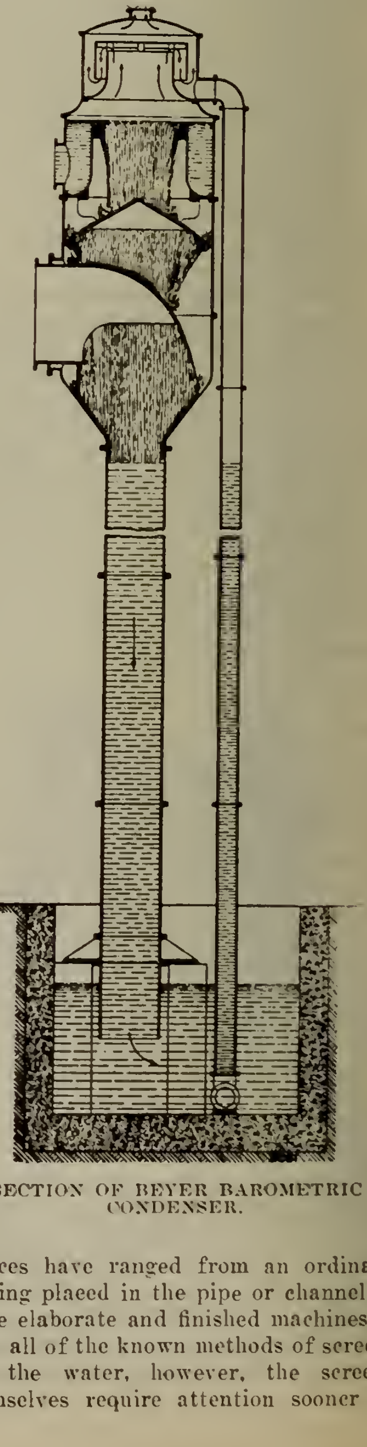
INSTALLATION OF BEYER BAROMETRIC CONDENSER.

The Beyer barometric condenser is of the counter-current type, in which air and cooling water flow in opposite directions. The steam inlet is at the bottom of the condensing vessel, the water inlet above, and the air removal opening at the top. The sheets of cooling water overflowing the pool at the inlet point meet the entering steam. The two are brought into intimate contact by conical baffle plates assisting the water to absorb to its full capacity the latent heat of the steam. The non-condensable air liberated by the condensing action rises through the falling water to the removal point at the top, being cooled to practically the temperature of the incoming water. It is also to be noted that ample opportunity is given for the removal of the air content of the water before it mixes with the steam. This the manufacturers point out not only facilitates the mixing process, but permits the removal of air and vapor at a comparatively low temperature, a distinct advantage, as the reduced volume saves in vacuum pumpage horse-power.

The steam inlet is of large diameter to secure low velocity, and is hooded in such a way as to discharge the steam into the centre of the condensing vessel. The air removal opening is also of ample area, and is protected by a self-draining baffle and trap. This, is it said, positively prevents water being carried over into the vacuum pump. The hot waste water is discharged through the self-draining tail pipe, this pipe straddling the hot well and rigidly supporting the condenser.

The Imperial and Ingersoll-Rogler vacuum pumps are of standard type. They are high-speed reciprocating machines, wholly enclosed, automatically lubricated, and are claimed to economize floor space. When a water pump is required to elevate cooling water to the condenser head, Cameron pumps are provided, these being either reciprocating or centrifugal as desired. Where the level of the cold well is of sufficient height above the hot well, the condenser will lift its own cooling water, dispensing entirely with a water pump.

With this equipment it is claimed that the vacuum and water pumps, being independently operated, can be regulated to suit varying water temperatures and conditions, that in addition to efficiency in general service, such a plant is well adapted for duty as a central condensing unit serving a number of prime movers.



SECTION OF BEYER BAROMETRIC CONDENSER.

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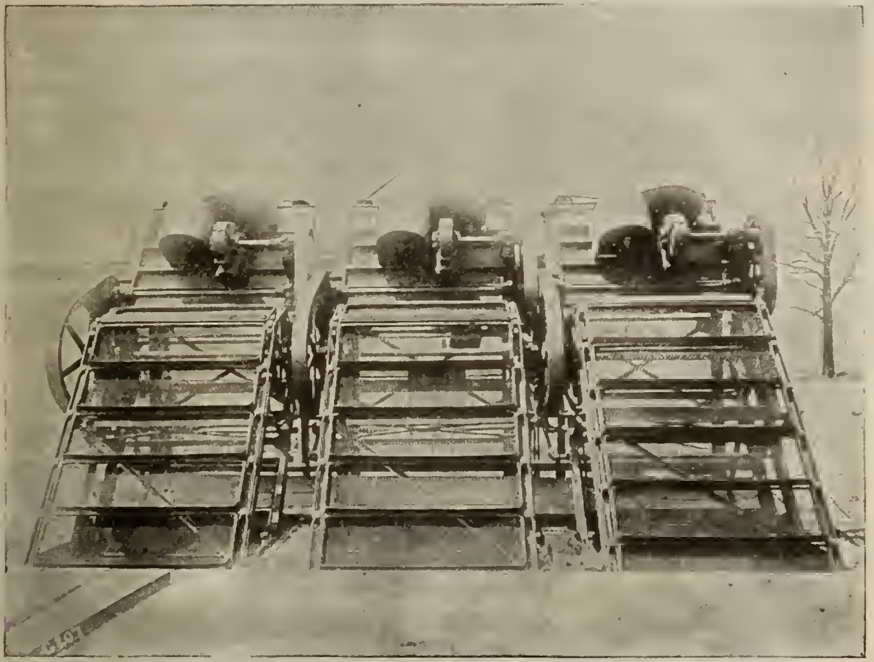
SELF - CLEANING TRAVELING WATER SCREENS

THE necessity for clean circulating and boiler water in power plants has become so much of an accepted fact to-day that it is not necessary to make explanation of it in order to introduce the subject of screens for screening this water. Ever since water has been used for this purpose there have been various devices for screening it and removing at least the larger pieces of foreign matter. These devices have ranged from an ordinary grating placed in the pipe or channel to quite elaborate and finished machines.

In all of the known methods of screening the water, however, the screens themselves require attention sooner or later. This attention meant, in some cases, a great amount of labor and difficulty, and the screening of some of the devices was more or less ineffective, principally at times when cleaning was in progress.


SELF-CLEANING TRAVELING WATER SCREENS

Every engineer is familiar with the fact that no matter how many sliding screens are placed in an intake one after the other, when each screen is raised a certain amount of sediment drops down and passes under it and on to the next one. This process repeats itself until the last screen is raised and then the droppings enter the intake to the power plant and are carried into the pumps and condenser tubes where they hasten the necessity for cleaning these auxiliaries.

It was with a view to improving the conditions outlined above that a few years ago the Chain Belt Co., built three machines known as the "Chain Belt Self Cleaning Traveling Water Screens." These were installed at the northwest plant of the Commonwealth Edison Co. in Chicago.

The accompanying illustration shows the original three screens which have been in continuous operation since their installation.

The early experience of the Chain Belt Company has enabled them to make many improvements and developments in the mechanical design so that the screens built at present are quite different from the original installations. The machines consist essentially of wire screening baskets mounted on two strands of steel chain belt. These chain belts and screens form a continuous screening apron which pass over sprockets at the top and bottom of the device, and are mounted on a structural steel supporting frame. There are lips on the baskets and as this screening apron moves through the water slowly and in an upward direction it carries with it particles screened from the water. After turning over the head sprockets it deposits them in a trough from which they are flushed into the river on the down stream side. The cleaning of the screen baskets is effected by having a spray pipe running back of the screen baskets which forces a continuous spray of water through the screens from the back.

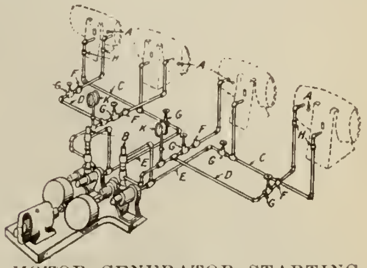
In the majority of installations these screens have been placed on an incline as shown on the cut, but there are several installations which have been built in a vertical position.

* * *

FORCED LUBRICATION FOR STARTING MOTOR GENERATOR SETS

EXCEPTIONALLY large motor generator sets and other similar machines can be started with comparative ease if the bearings are first flooded with oil. Writing in the General Electric Review on "Some Recent Developments in Central Station and Sub-station Equipment," J. R. Werth describes a special oiling system for the four bearings of a very large motor generator set, operating as a frequency changer. Prior to the installation of that oiling system, the large starting motor had to exert an enormous torque to "break" the shaft from its bearings, especially after the set had been shut down for some hours.

The difficulty has been overcome by the installation of a special oiling system shown in the accompanying illustration. A small ¾ horse-power motor driven pumping set forces oil between the shaft and the bearings of the frequency-changing set, thus floating the shaft on a film of oil. It is now possible to start the set without any special starting motor, thereby saving valuable floor space and eliminating the continuous loss of energy involved in keeping the starting motor revolving twenty-four hours a day. After the set has been started sufficient lubrication is provided by the usual oil rings.



MOTOR GENERATOR STARTING ARRANGEMENT.

It will be gathered from the illustration that there is one pump for each pair of bearings, and that both pumps are driven by the single ¾ horse-power motor. The holes in the bearings shown at A are for water-cooling connections. Relief valves are shown at B, equalizing pipes at C, pressure pipes at D, feed pipes to pumps at E, check valves at F, control valves at G, insulating couplings at H, and pressure gauges at K.

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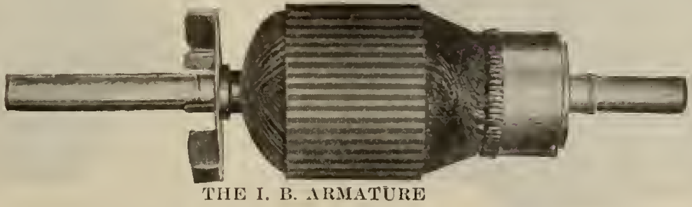
D. C. MOTORS OF LOW HORSE POWERS

TO meet a demand for direct current motors of the smaller horse powers for direct connection to and driving all kinds of industrial machinery, machine tools and other applications requiring a low-power compact machine, the C & C Electric & Mfg. Co., of Garwood, N.J., has developed a new line of specially designed motors.

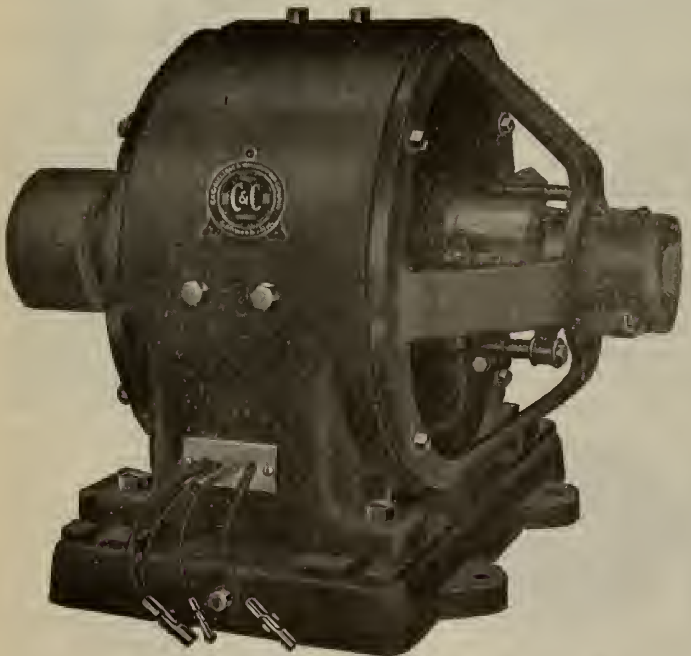

THE I. B. ARMATURE

They are known as Type IB, are bipolar with interpoles, and can be furnished in ratings up to 10 h.p., either shunt or compound wound. For a general manufacturing drive, such as for machine tools and other industrial machinery, the characteristics of the shunt wound motor are the most desirable. It is essentially a constant speed machine, having close speed regulation from no load to full load, and is recommended for all purposes where the torque required for starting and accelerating does not greatly exceed full load torque. The compound wound motor is desirable for drives where the starting torque is much heavier than the full load torque. This motor starts at a much heavier load than does the other, and any degree of compounding can be furnished to meet conditions.

The materials entering into the manufacture of these motors and their design are such as to make a compact machine, sturdy both electrically and mechanically. The main frame and supporting feet are cast integral, the pole pieces being separate. The main pole pieces and pole shoes are laminated. The interpole pieces are separately cast and the coils are all form wound. The pulley side bearing bracket is provided with a wide apron to protect the winding from mechanical injury, and the bearing supported by four arms with large openings between, makes a rigid open bracket, permitting free and ample ventilation. The commutator side bearing bracket has four arms, giving also a rigid bracket and free access to the commutator and brushes. Both brackets fit in a recess in the main frame, insuring thorough and rigid alignment.

The armatures are of standard design with laminated core. An air agitating fan is placed on the pulley side of the shaft next to the armature winding to furnish the high degree of ventilation and cooling so necessary in motors of small compact frame, guaranteeing severe service and heavy overloads. The addition of interior commutating poles forms another desirable feature. In continuous operation for long periods, these motors have been found to run cool and without attention. The interpoles make possible sparkless commutation through the full range of load without changing the brush position.

This new line of motors is furnished in the open type, or with perforated or totally enclosing covers for protection against dust, metal chips, dampness, etc. For belt drive the motors can be furnished with either a universal slide rail base or a belt tightener idler pulley.

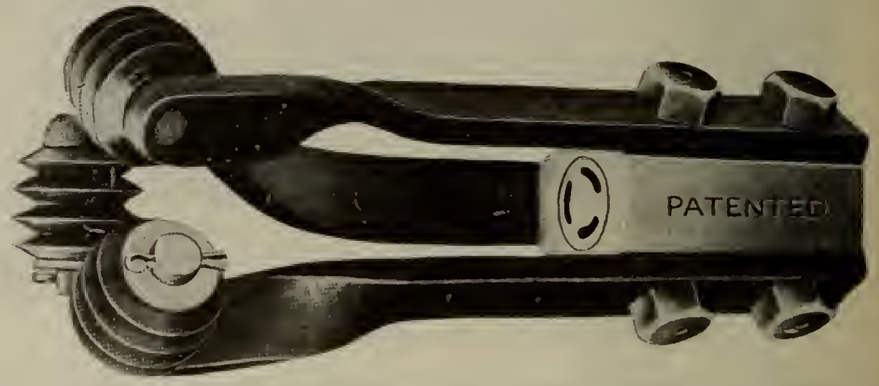

C & C TYPE I. B. MOTOR WITH UNIVERSAL BASE

MAIN FRAME WITH FIELD AND COMMUTATING POLES

* * *

TUBE SCRAPER

THE tube scraper illustrated, and known as type K.C., is a product of the Babcock & Wilcox Co., Toronto, Montreal and London, England, and forms an accessory to their well known water-tube boilers. A special claim made for this scraper is its efficiency in dealing with hard scale. The scraper is attached to a length of wrought iron tubing screwed ¾ in. gas thread, which in turn is connected to a water supply by means of a rubber hose for conveying a small stream of water through the centre of the tool, in order to cool the cutters and wash away the scale removed. A small tap is fixed between the wrought iron tubing and the hose for regulating the water supply. The cutting edges of the rollers are of a radius to suit the size of tube, being contained within a circle the same diameter as the inside diameter of the latter. It will be seen, therefore, that, when all scale has been removed, the rollers will not cut into the surface of tube. To operate, remove the hand-hole caps, insert the scraper, turn on the tap at the top end of handle, and allow the water to flow. At the same time, move the scraper up and down the tube, slightly twisting the handle while doing so, until the apparatus comes out at the bottom of the tube. Twice down should be sufficient to thoroughly clean the tube it is claimed.



TUBE SCRAPER FOR B. & W. WATER TUBE BOILERS

Sunderland, Ont.—T. Welsh is in the market for two 15-h.p., three-phase, 220-volt, 60-cycle squirrel-cage motors.

Projects and Developments

Trade Gossip

Guelph, Ont.—The City Council are in the market for a 750 h.p. transformer.

Montreal, Que.—The Town Council of Pointe aux Trembles, near here, contemplate installing a waterworks system.

Birchcliff, Ont.—The ratepayers of this district have endorsed a scheme for installing a hydro-electric system.

Kaslo, B.C.—P. Burns & Co. will equip their branch market at Kaslo with a 1-ton Armstrong refrigerating machine.

Toronto, Ont.—The William Davies Co., will install a cold storage and ice plant at their packing house in this city.

Peace River, Alta.—The Department of Public Works, Ottawa, contemplate the installation of an electric generating plant.

Sault Ste. Marie, Ont.—An extensive waterworks system is contemplated by the town council, which will cost over $250,000.

Moose Jaw, Sask.—The City Council, will spend $12,300 on extensions and the installation of new equipment in the power plant.

The Storey Pump & Equipment Co., Toronto, have been awarded a contract for pumps and filtration plant for Niagara-on-the-Lake, Ont.

Pembroke, Ont.—The Pembroke Electric Lighting Co. are having plans prepared for a sub-station by R. S. Kelsch, Power Building, Montreal.

St. Catharines, Ont.—The Packard Electric Co. are building an addition to their factory, 50 ft. x 145 ft., of steel and concrete construction.

Stellarton, N.S.—The Acadia Coal Co. contemplate installing an additional unit in their power plant. This will consist of a 3,000 k.w. steam turbine.

The Chapman Valve Co., Toronto, will supply a number of valves to the Metagami Pulp & Paper Co., for their new paper mill at Smooth Rock Falls, Ont.

Orillia, Ont.—The Town Council have awarded a contract to the Boving Hydraulic & Engineering Co., Lindsay, Ont. for three water turbines to cost $29,300.

The Taylor Engineering Co., Vancouver, has secured a contract for six fuel oil engines made by Bollinger, of Stockholm, Sweden, to cost about $95,000.

W. K. Jeffrey, formerly manager of the Ottawa Car Mfg. Co. has joined the Lyman Tube & Supply Co., as sales manager, with headquarters in Montreal.

New Toronto, Ont.—The Village Council has decided to purchase a new pump for the waterworks system. It will have a capacity of 600 gallons per minute.

Ford, Ont.—The Westgate Ice Cream Co., it is reported, has had its ice cream factory equipped with a 6-ton "York" refrigerating plant and dry hardening system.

Winnipeg, Man.—The Board of Control have recommended the purchase of a motor to drive 5,000,000-gal. pump at the waterworks. W. P. Brereton is city engineer.

E. R. Gray, assistant city engineer of Hamilton, Ont., has been recommended by the Board of Control for the position of chief engineer, to succeed A. F. Macallum.

Riondel, B.C. — The New Canadian Metals Co., is having installed a 1-ton refrigerating and ice making plant furnished by the Armstrong Machinery Co., Spokane, Wash.

Silverton, B.C.—Herman Clever will have his meat market equipped with a 1½-ton refrigerating machine, furnished by the Armstrong Machinery Co., Spokane, Wash.

South Vancouver, B.C.—P. Barker is having his meat market equipped with a 3-ton refrigerating machine, furnished by the Armstrong Machinery Co., Spokane, Wash.

Bowmanville, Ont.—A by-law has been registered to authorize an expenditure of $9,000 for the purpose of completing the waterworks and sewerage systems now under construction.

Vancouver, B.C. — The Ocean Falls Pulp & Paper Co., will install a 7-ton refrigerating machine, contract for which was let to the Armstrong Machinery Co., Spokane, Wash.

Toronto, Ont.—The city architect has issued to the Hospital for Sick Children a permit for the erection on Laplante avenue, near College, of a one-storey brick and concrete power house to cost $9,000.

Bella Bella, B.C. — The East Bella Bella Cannery, north of Vancouver, is having its cannery equipped with a 5-ton refrigerating machine, contract for which was let to the Armstrong Machinery Co., Spokane, Wash.

The Canadian Gasoline Corporation have acquired the Canadian rights for the "Greenstreet" process for making gasoline, H. T. Bush, president of the Standard Ideal Co. of Port Hope, Ont., is a member of the syndicate.

Sarnia, Ont.—The City Council has decided to spend $5,000 upon three experimental infiltration basins for the waterworks plant. The basins will be 18 ft. long, 12 ft. wide and 10 ft. deep. Waterworks engineer, James Turner.

Lethbridge, Alta.—The city council are considering the installation of a mechanical filter with a capacity of three million gallons per day. A by-law will be submitted to the ratepayers to authorize an expenditure of $100,000 on the plant.

Kingston, Ont.—The ratepayers on June 19 voted to ratify an agreement for a supply of electrical power from J. M. Campbell at Kingston Mills to the Utilities Commission. From 300 to 600 horse-power is being secured at three-quarters of a cent per kilowatt hour.

Orillia, Ont.—Orillia Water, Light and Power Commission has announced a further reduction in rates for electric lighting, varying from 7½ to 15 per cent. The reduction applies to both flat and meter rates, and commercial and domestic services, and is effective forthwith.

Halifax, N.S. — Tenders were received until Wednesday, July, 19, 1916, for furnishing 2,800 ⅝ in. meters and 300, ¾ in., meters in accordance with the specification made by the City Engineer, H. W. Johnston.

Stratford, Ont.—The city council, in a special session on July 6, passed the by-law for $30,000 debentures to take care of extensions and improvements to the local Hydro-electric distribution system recently made. The money is to be procured from the Ontario Railway and Municipal Board.

Winnipeg, Man.—In accordance with the Steam Boiler Act, an Order-in-Council was passed recently dividing Manitoba into 18 boiler inspection districts. A map has been prepared showing the districts, the boundaries of which are given below. A number of the inspectors have been appointed, but in other cases the selected men have not passed the examination as yet. The inspectors will be paid according to the work done. The reason for the greater number is to obtain efficiency.

Woodbridge, Ont. — E. A. James, county good roads engineer, has been engaged by the council to prepare plans of a system of water supply for the village. It is not likely that the people will vote on this question before January. The proposed system will cost about $40,000, and will include mains, pumping station, filtration beds and standpipe.

The Chapman Engine Mfg. Co. has been incorporated at Ottawa, with a capital of $250,000, to manufacture engines to be run by gasoline, kerosene and steam power, also electrical motors, machinery, tools, etc., at Dundas, Ont. Incorporators: G. W. Williams, F. E. Lennard, and J. D. Pennington, all of Dundas, Ont.

Wolfville, N.S.—Work has been started on the Bay of Fundy tide power project at Cape Split, N.S., by the Cape Split Development Co., of Wolfville. R. P. Clarkson, formerly an electrical expert for United States Government, in consultation with other eminent engineers, is directing the work. Power will be generated by means of the tidal currents for distribution throughout the district.

Large Power Plant Project.—It is understood that plans will shortly be prepared for the construction of a new municipally-owned hydraulic power plant by the City of Montreal, the cost of the latter, including equipment, being in the neighborhood of one and a half million dollars. Contracts for the buildings and equipment are expected to be placed during the coming winter. The projected installation is in connection with the new aqueduct scheme.

Renfrew, Ont.—Engineer Kribs, of the Hydro-Electric Commission, has sent a report to the Town Council respecting the investigation of power possibilities made by him for Renfrew at the first and fourth chutes of the Bonnechere River. He finds that at the first chute 1,500 h.p. can be developed, and at the second, 2,000 h.p. The cost of development and delivery in the one case would be $200,000, and in the other, $300,000. Each chute is located within a few miles of Renfrew, which is in pressing need of more electric power.

Orillia, Ont.—The Water, Light and Power Commission have awarded the contracts for the electrical machinery for the new power plant at the Swift Rapids to the Canadian General Electric Co. The contract price for two units, with a capacity of 3,600 h.p., is $68,000; for three units, with a capacity of 5,400 h.p., $81,000. The decision as to whether two or three units shall be installed has been deferred until the negotiations with the Hydro-Electric Commission for supplying them with the additional power required by their Severn system have been completed.

Windsor, Ont.—An important session of the Essex Border Public Utilities Commission was held at the City Hall here on June 28, and at its conclusion it was announced that the commission had ratified the appointment of a Board of Engineers to prepare comprehensive plans for a joint sewage and water system for the six Canadian border municipalities. When the plans are perfected the ratepayers of Windsor, Walkerville, Sandwich East, Sandwich West, Ford and Ojibway, the municipalities affected, will be asked to vote on the project. The approximate cost of a new sewerage system for the border towns is estimated at between $1,500,000 and $2,000,000.

Steam Turbo Alternator, Etc.—The corporation of Invercargill, New Zealand, is calling tenders for a steam turbo alternator, condensing plant and switchgear. The contract to be let is for the manufacture, supply, delivery and erection, duty, railage, and all other charges paid, including all labor in buildings and upon foundations constructed by the corporation of all plant and material required for a steam turbo alternator complete with necessary condenser, fittings, auxiliaries and all apparatus, whether specified or not particularly mentioned necessary for proper and efficient operation of the plant. Tenderers must state in what time they will guarantee to complete the whole of the contract, including all tests; time to date from acceptance of tender. Such acceptance may be by letter, telegram or cable. Specifications and plans may be obtained by writing to the Commercial Intelligence Branch, Department of Trade and Commerce, Ottawa, referring to File A-1939.

Catalogues

The Dearborn Chemical Co. of Canada, Toronto, have issued a bulletin dealing with the treatment of boiler feed water. The composition of feed waters, the substances most commonly present, and their effect, are first described, followed by a description of the "Dearborn" method of treatment and their boiler preparations.

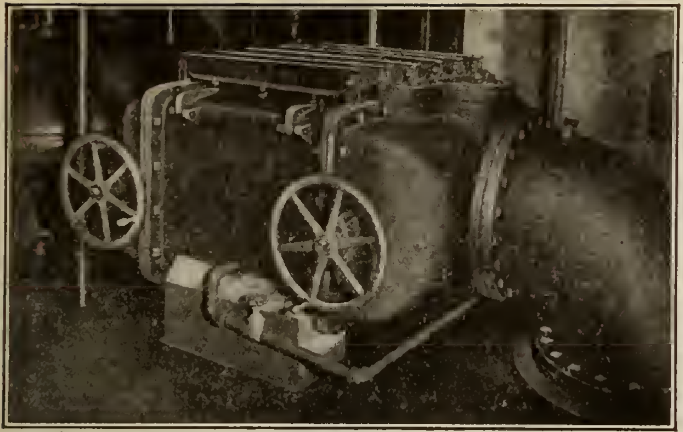
The "S-C" Regulator Co., Fostoria, Ill., have issued bulletin No. 24, containing a description and specifications covering the "S-C" feed water regulator also the generator and regulating valve. The illustrations show typical installations and sectional views of the generator and valve, half actual size.

The Terry Steam Turbine Co., Hartford, Conn. have issued an informal booklet describing a combination of auxiliary machinery called the duplex exciter. It is claimed that for nearly all large steam generating stations these duplex exciter sets have shown some striking advantages over any other source of excitation.

Electric Motor Pump.—A new bulletin issued by the Buckeye Pump & Mfg. Co., Columbus, Ohio, describes and illustrates the new "Buckeye" automatic electric motor pump. Two types are dealt with, for direct pressure and open tank service respectively. A specification is included covering the principal features of these outfits.

Graphite for Cylinder Lubrication is the title of an attractive little booklet dealing with the above interesting subject and issued by the Joseph Dixon Crucible Co., Jersey City, N.J. The booklet tells of graphite lubrication for both steam and gas cylinders and also gives concise facts about lubricators that are made to use graphite alone or with oil.

"Vim" Leather Packings are described at length in a bulletin issued by the E. F. Houghton & Co., Philadelphia, Pa. The principal features covering the material and process of manufacture are dealt with fully together with sectional views for use when ordering these packings. Price lists are included for the various styles of "Vim" packings, check valves and plunger leathers.



24" Twin Strainer in condenser circulating water line.

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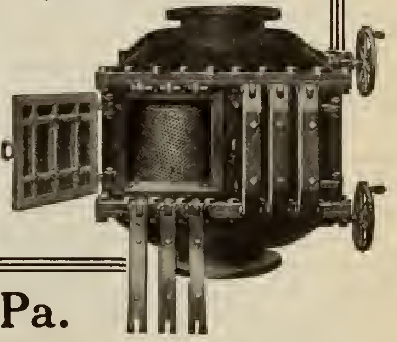
Insure Continuous Service

The Twin Strainer stands on guard twenty-four hours a day, and removes from the water all such foreign matter as dead leaves and grass, sticks, fish, etc., that would clog up and injure the pump and condenser.

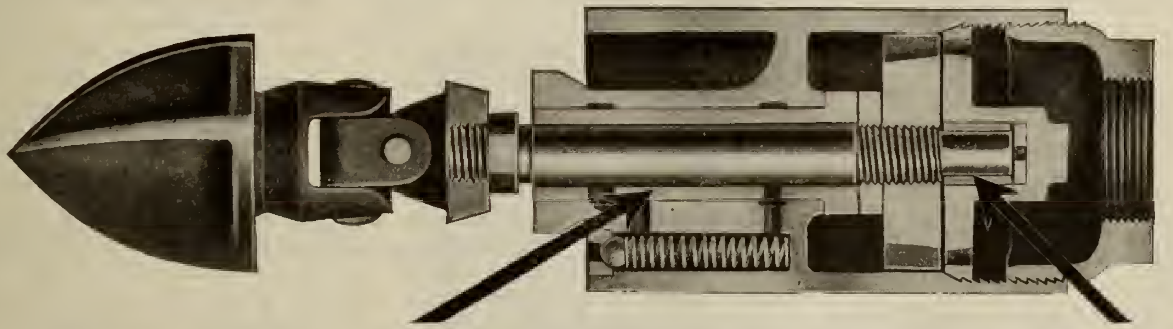
The Twin Strainer is the only direct-flow strainer that can't be clogged. When the solids accumulate in one of the two straining baskets, a clean one is put in service by simply operating two valves. The dirty basket can then be lifted out, carried to a convenient place, cleaned, and replaced in the Strainer—all this without interrupting the supply of water for an instant.

Twin users are the best boosters we have. Send for a copy of Bulletin "A" and join the army.

Twin Strainers are made in sizes ranging from 1 to 48 ins. with perforations in the straining baskets to suit your service.



Elliott Company, 6902 Susquehanna St., **Pittsburgh, Pa.**



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Because the weight of the rotating parts is so small that the friction load on any type of bearing in good condition is negligible compared with the load of removing scale.

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The LIBERTY CLEANER uses bushed bearings which do stand up under shock and which are practically impervious to grit. On account of wear, the friction load on ball or roller bearing Tube Cleaners increases rapidly with use. Friction load on LIBERTY bearings does not increase.

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Canadian Representatives: Williams & Wilson, Ltd., Montreal; A. R. Williams Machinery Co., Toronto and Winnipeg

If any advertisement interests you, tear it out now and place with letters to be answered.

Spray Cooling System.—The Spray Engineering Co., Boston, Mass., have issued bulletin No. 101, entitled "Sprays for Cooling Condensing Water." A general description is given of the "Spray" cooling ponds, including particulars regarding their economy, power requirement, cooling capacity and design of the spray nozzle, while results of tests are also included. The cuts show a number of installations at various industrial plants.

The New York and New Jersey Lubricant Co., New York, have issued a series of bulletins dealing with "Non-fluid Oil" and its various applications, more particularly for textile, saw mill, and wood-working machinery and ring oiling bearings. The benefits obtained by the use of this oil are set forth and the class of work for which each grade is best suited is stated. Copies of these bulletins may be obtained on application to Fred Smith, 24 King street, west. Toronto.

Gate Valves.—The latest catalogue issued by the Nelson Valve Co., Philadelphia, Pa., deals with extra heavy steel gate valves for superheated steam and other power plant service. This is a very comprehensive booklet on the subject and is a handy reference for specifications and prices. The various types of valve are illustrated and described while tables give the price and principal dimensions for each size. Copies of this catalogue will be gladly furnished on request.

Coal and Ash Gates.—The C. W. Hunt Co., Inc., West New Brighton, New York, have issued a new valve catalogue, No. 153, dealing with the "Hunt" coal and ash gates or valves for controlling the flow of bulk materials. The catalogue contains a complete description of standard types of valves, accompanied by illustrations showing the general features. Dimensions are given of those types which are most frequently used in power house and storage pocket design. Numerous cuts are included showing the application of these valves, and selected with the idea of assisting where there is any question as to the type best suited to requirements. The catalogue, 6 in. x 9 in., contains 28 pages, and copies may be obtained on application by those sufficiently interested.

Wiring Rules.—The seventh edition of "The Wiring Rules of the Institution of Electrical Engineers" has just been issued. The alterations that have been made are largely matters of detail. but the following points may be noted:—The clause relating to gas pipes is strengthened, and combined gas and electric fittings are not to be used. If gas fittings are adapted they must be entirely disconnected from the gas piping. The test for cables has been somewhat modified. A pressure of 1,000 volts for half an hour is stipulated for 250-volt cables, but this is increased to 2,500 volts for 650-volt cables. These grades of cable are defined by the radial thickness of dielectric and the insulation resistance. The testing current is to be alternating at a frequency of 50-100, and the alternator must have an output of not less than 5 kilowatts. Some modification has been made in the specification of flexibles, and bunching in wood casing is allowed to a larger extent. As regards lead-covered conductors, these must be exposed to view; but it is not clear whether this clause covers Henley's special system. Switches having handles projecting from an open slot in the cover are now barred. Definite distinguishing colors are recommended for positive. negative and neutral conductors, and for three-phase conductors.

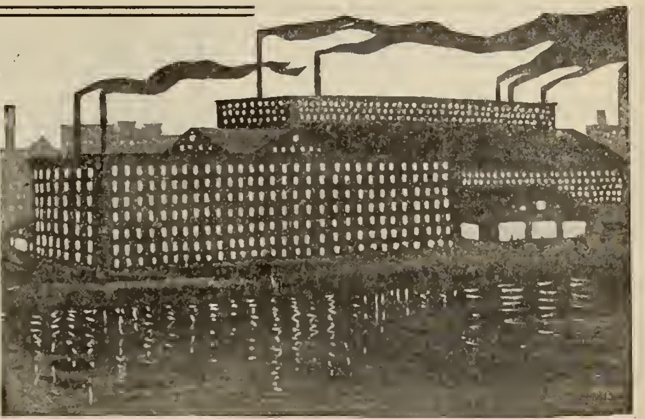
Recording Instruments.—Instruments for recording carbon dioxide in flue gases are described in Bulletin 91, of the Bureau of Mines, Department of the Interior, J. F. Barkley and S. B. Flagg, authors. In explaining why the Bureau of Mines has issued a report of this character, the authors say: "In the past few years an awakened activity in power plant economies has resulted in a marked improvement in the equipment for generating and utilizing steam. Although the improvement in design and construction of steam-driven prime movers has been greater than that of the steam-generating equipment the economies obtained with the more efficient engines and turbines have stimulated interest and activity in eliminating unnecessary boiler and furnace losses. Much attention has been given to the boiler room in efforts to obtain proper combustion of the coal, because of the importance of the coal item in costs of power production. As evidence of this increasing interest may be cited the record of the development within the past few years of new apparatus for the analysis of flue gases. Many new forms of apparatus have appeared, including those for the determination of carbon dioxide, oxygen, and carbon monoxide, and others for indicating and for recording the content of carbon dioxide only, as carbon dioxide content is usually a good indicator for the control of furnace operation. Because of the large number of steam-power plants operated by the Federal Government and the number of carbon dioxide recorders used therein the Bureau of Mines undertook to collect information regarding the practical application of such recorders. Articles published from time to time concerning carbon dioxide recorders have been mostly descriptive, giving little reliable information as to the results that could be expected from the various types of instruments in ordinary practice, and most of the tests made have been of a laboratory nature. Tests of several different types of recorders were made under service and laboratory conditions in order to obtain needed information. The purpose of the Bureau of Mines in publishing the results is to show the factors which may affect the accuracy of a carbon dioxide recorder and the manner in which a recorder should be tested. Copies of this bulletin may be obtained free of charge by addressing the director of the Bureau of Mines, Washington, D.C.

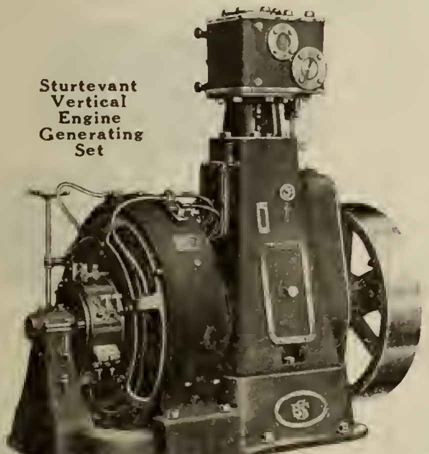
Book Reviews

Manuel Pratique des ingenieurs mecanicens, chauffeurs, machinists, by J. A. Bourbonniere, Published by Imprimerie Mercantile, Montreal, Que. Price $1, net. This is a new publication of pocket book size, written in the French language, specially for engineers, mechanics and boiler operators, and for those in charge of power plants. The author, who is a boiler inspector for the Province of Quebec, has treated the subject in a thoroughly practical manner and the book will be particularly interesting to those desiring to obtain a practical knowledge of steam boilers and fittings. The first section of the book contains extracts from the Quebec Stationary Engineers Act, qualifications of and rules for the examination of stationary engineers, rules covering the inspection of boilers and fittings, etc. The second section takes the form of questions and answers, and deals with the elemental principles and constituents of air, water, steam and fuels. Matter dealing with the construction and operation of steam boilers follows, the various fittings of the latter including traps, injectors, separators, etc., being discussed at length. The design and operation of the more common types of steam engines and boiler feed pumps are treated at considerable length, the application of horse power and other formulae being also shown. The concluding section contains a series of useful mechanical tables in English measure, boiler riveting rules, etc. Numerous illustrations, and considerable advertising matter of use as a directory, are to be found in the 165 pages of this little publication.

Modern Starting, Lighting and Ignition Systems, by Victor W. Page, nearly 400 pages, 5½ in. by 8 in., and over 250 illustrations with folding plates. Published by the Norman W. Henley Publishing Co., New York. Price $1.50. This volume explains all forms of electrical ignition systems used on internal combustion engines of various types, and deals with the equipments of cars built in previous years as well as those

Why Run the Big Engine When Only Part of the Force Is Working?





Sturtevant Vertical Engine Generating Set

When only part of the force is working at night it wastes money to run the large engine. This is a useless expense which can be done away with by installing a

Sturtevant Engine Generating Set

They are small units made in sizes up to 100 kilowatts with vertical engines and up to 150 kilowatts with horizontal engines. In some plants they will carry the whole load. A decided saving can be made with one suited to your needs. Sets with turbine drive are also furnished.

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Even if you have no natural supply of cool water, such as a river or pond, you can maintain a 28″ vacuum in your condenser and do it at low cost with a

SPRACO COOLING POND

The Spray System of cooling requires a relatively small amount of water. The first cost of the system is less than for a cooling tower, the operating cost is about one-half as much, and there is practically no depreciation.

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A perfect mixture of Flake Graphite and mineral grease is the whole secret.

Let us know your lubricating problem. We will tell you how to solve it. If you specify for what use, a sample can will be sent.

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in use this year. It also includes comprehensive instructions pertaining to the starting and lighting systems of automobiles. The book is essentially practical. While of considerable value to the mechanic, it has been written with special reference to the requirements of the non-technical reader, who may desire easily understood explanatory matter relating to all types of automobile ignition, starting and lighting systems. The aim of the author has been to present a book that can be understood even by those whose knowledge of electrical matters is limited. In order to help the reader who is deficient in this respect, elementary electrical principles are dealt with at length in chapter one, the succeeding chapters dealing with the various systems covering construction and operation. Chapter two describes different battery and coil ignition methods, while the following chapter deals with magneto ignition systems. Elementary electric starter principles are discussed fully in chapter four, and in chapter five typical starting and lighting systems are described in detail. Chapter six deals with starting system faults and their systematic location, while chapter seven is devoted to a description of miscellaneous electrical devices. The illustrations, which are very explanatory, are from specially-prepared engravings; in addition, there are some interesting folding plates. The book is bound in attractive and substantial cloth covers, and the reading matter is printed in clear type.

The Shipping World Year Book, 2,010 pages 7¼ in. x 4½ in., edited by Major E. R. Jones, and published from the "Shipping World" offices, London, England. Price 11s. ($2.75) net. The 1916 or thirtieth edition of this year book contains, as in former years, much valuable information for all interested in shipping. It is a very useful publication for shippers and merchants trading in all parts of the world, and is also a very handy book of reference as the information given covers a wide field The war has of necessity made the compilation of this work no easy task, as it has effected profoundly the commercial and shipping interests everywhere. This circumstance, however, has not detracted materially from the value of the book, as it has been brought up-to-date as far as possible from available data. The book is arranged in three sections, the first or general section deals principally with matters affecting navigation and shipping embracing a digest of merchant shipping acts, alien and factory acts, customs regulations, etc., also numerous tables embodying much valuable information. This section has been revised and some pages rewritten owing to restrictions imposed by the war, while new features have been added to bring the matter up to date. The second section is devoted

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Means immense economy in fuel because it returns condensation back to the boilers HOT, up to 300 degrees F.—100 degrees hotter than is possible with a pump. **Saves water, oil and time, too.**

The "Cole" is utmost in efficiency and reliability, and returns condensation at any pressure.

Operates on roller bearings, on a fixed fulcrum which permits of **full discharge at each operation.**

Operates on one-tenth the steam that it takes to run a steam pump.

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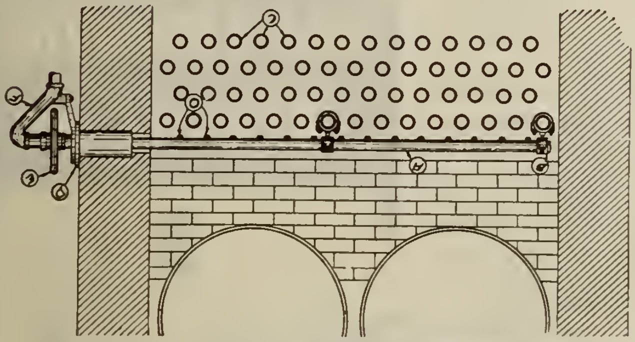

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You know that soot on heating surfaces means more fuel burnt. You know that if you clean by hand nozzle a few hours afterwards soot has deposited again.

Save 5 per cent. to 15 per cent. by installing Diamond Soot Blowers and clean **thoroughly and frequently** and without letting in cold air by opening the doors.

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75 H.P., 16 x 36 Leonard Corliss, used less than year; heavy duty type.
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72 x 18 horizontal return tubular, shaking grates, Government inspected.

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200—300-light dynamos.
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Works Equally Well on Hot and Cold Surfaces. It Cannot Blow Up. Cleans, Polishes and Preserves all kinds of metals.

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to a port and harbor directory of the British Isles, the Overseas Dominions and Foreign Countries. The geographical location of each port is given, together with particulars regarding water levels, anchorages, harbor dues, port officials, etc. The third section gives the customs tariffs of all nations brought up-to-date as far as possible under the present conditions. The tariffs of enemy countries have of necessity been left as they were in the 1915 edition, but considerable changes have been made in the Australian tariff, and also in that of the United Kingdom, the latter being entirely a war emergency measure. There is also a new map of the world showing trade routes, ports and coaling stations, etc. The book is of particular value now in view of the proposals which have been made to develop trade within the Empire and with our Allies. It is printed in clear type, has a very complete index, and is bound in substantial green cloth covers.

The Engineer's Year-Book, by H. R. Kempe, Crown 8vo. (7 in. x 5 in. x 2¼ in.) limp leather, gilt 1,500 pages, specially engraved illustrations. Published for the proprietors by Crosby, Lockwood & Son, London, England. Price $5 net. This is the twenty-third edition of Kempe's "Engineer's Year Book," of formulae, rules, tables, data and memoranda for 1916. It is so well known as to hardly need any introduction, and it is generally conceded to be one of the most useful reference books for engineers published. This edition has been enlarged, corrected and brought right up to date, and contains a large amount of new information covering the latest engineering practice. It covers a wide field and contains a great deal of valuable and reliable information for the use of engineers in the various branches of the profession, manufacturers, work's managers, draftsmen and power users. The Year Book forms a compendium of the modern practice of civil, mechanical, electrical, marine, gas, and mine engineering. There are thirty-five sections, each devoted to some branch of engineering, contributed or revised as the case may be, by well-known authorities on the different subjects, a sufficient guarantee of the reliability of the information contained. The illustrations which are exceptionally clear have been produced from specially prepared engravings. The book is printed on fine paper, has a 60-page index, and is bound in attractive red covers.

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On receiving information we will advise on best type of instrument.

This instrument measures the quantity of water or other liquid in a tank, well, stream or in almost any situation, and is absolutely free from mechanical devices, except for a small air pump at the instrument itself.

ALWAYS READY, ALWAYS SURE — ALWAYS KEEPS YOU POSTED ON THE QUANTITY OF LIQUID ON HAND, SAVES MUCH TIME AND PREVENTS "RUNNING SHORT."

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Nearly 5000 Engineers Read POWER HOUSE Every Month.

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"Yours sincerely,
"HENRY BERGH."

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Yours truly,

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Province .... Engineer with (firm) ....

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NOTICE

To Manufacturers, Dealers and Users of Steam Boilers

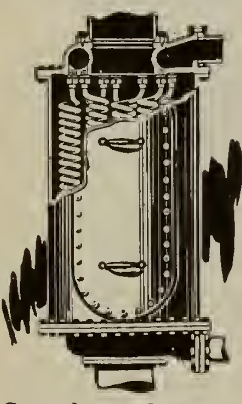
All steam boilers built in, or entering the Province of Ontario, and boilers exchanged or repaired are subject to Government Inspection as prescribed in the Steam Boilers Act, 3 George V., C. 61.

Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department, stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the Regulations by an Inspector authorized under the Act.

All communications should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G. MACDIARMID,
Minister of Public Works.

D. M. MEDCALF,
Chief Inspector of Steam Boilers.



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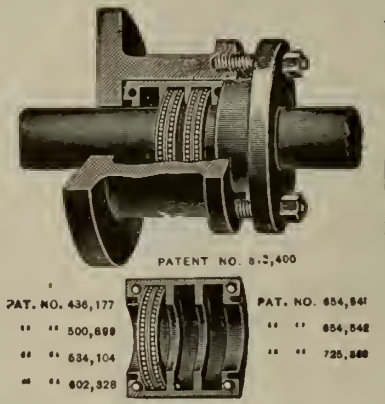

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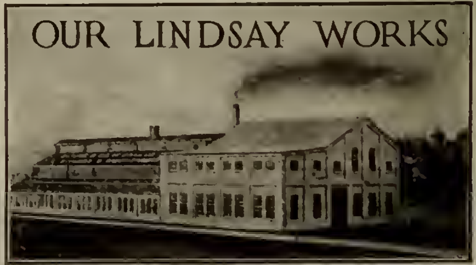

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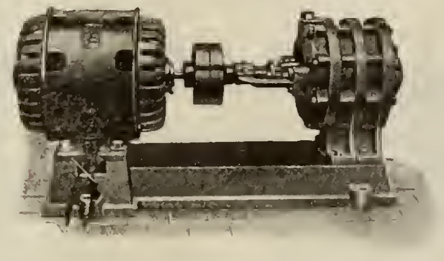

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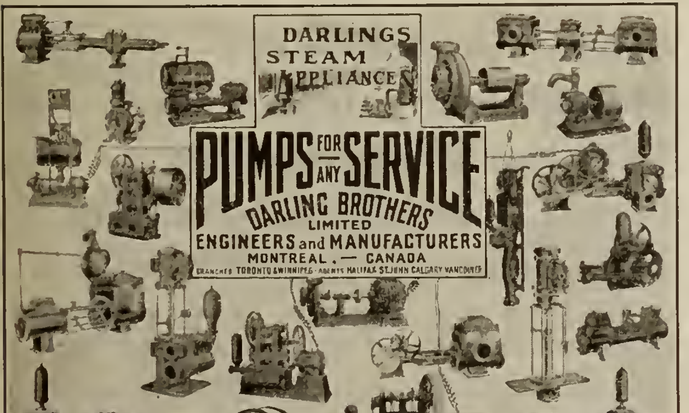
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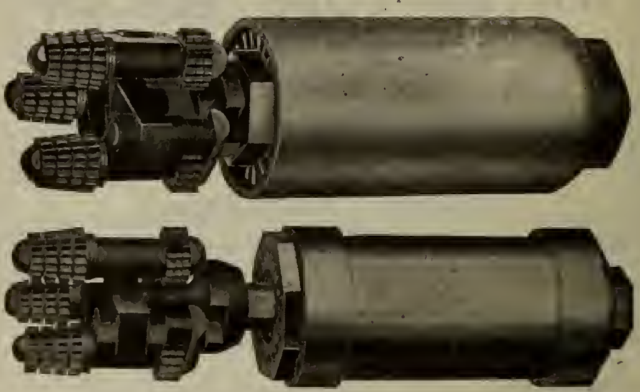

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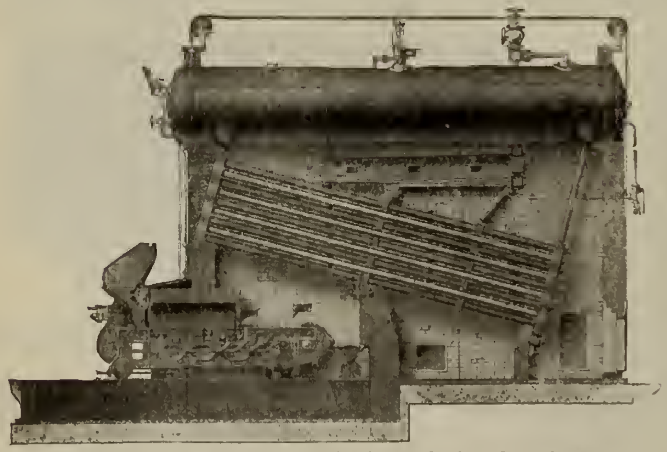

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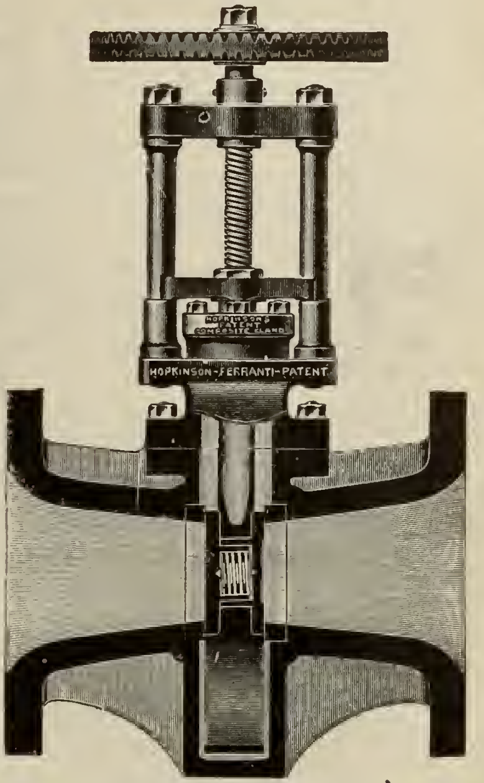

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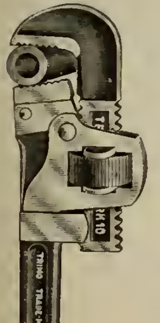
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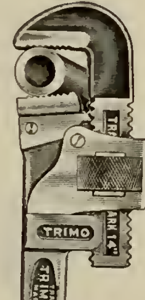

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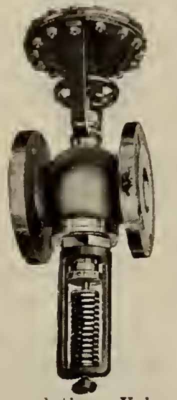

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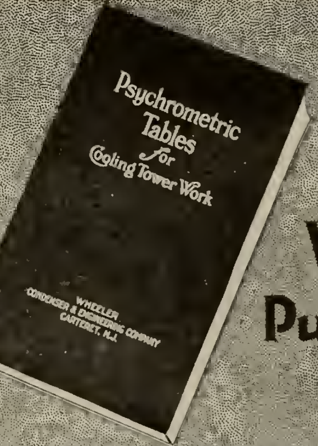
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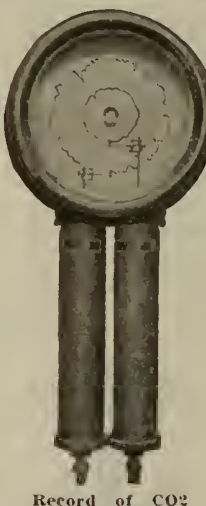

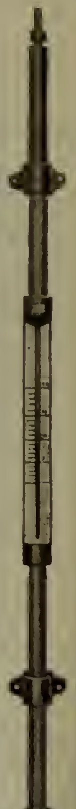

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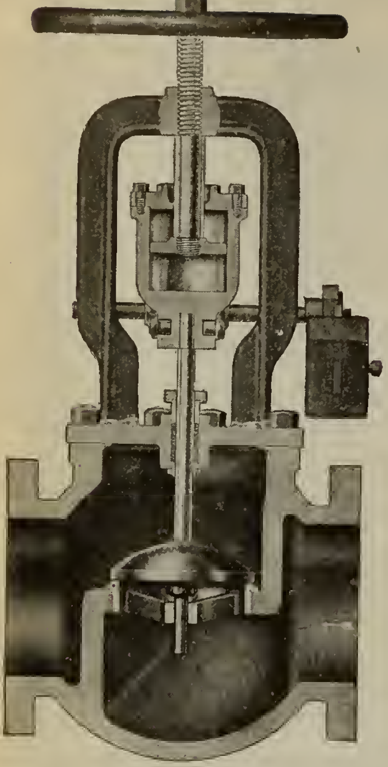

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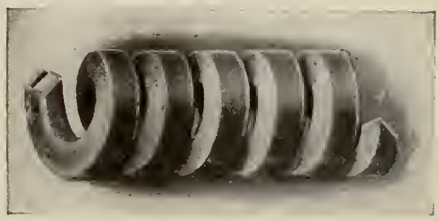

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If you are not visiting the Convention, write us for information on your packing requirements. Satisfaction guaranteed.

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Toronto, Ont.

Canuck Supply Co., Limited

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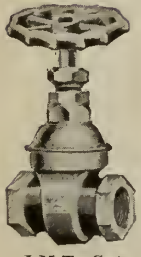
GEM EJECTOR

BOILER MOUNTINGS
STEAM SPECIALTIES
ENGINE SUPPLIES

Model "C" Safety Valve


J.M.T. Gate Valve

- STOP VALVES
- CHECK VALVES
- GATE VALVES
- SAFETY VALVES
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- REDUCING VALVES
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Pressure and Recording Instruments.

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J.M.T. Globe Valve, Renewable Disc.

Everything for the Engine and Boiler Room

Gauge Cock

Our Steam Goods are approved by Provincial and Marine Inspection Departments

Morrison Cellar Drainer, the most efficient machine on the market. All working parts above water.

Every article is tested before leaving our factory.

J.M.T. Injector.

While in many cases it is cheaper to buy new boiler mountings than to have them repaired, this cannot be said of steam specialties. We are fully equipped for handling repairs to gauges, recording instruments, injectors and specialties of every description

J.M.T. Reducing Valve will not equalize.

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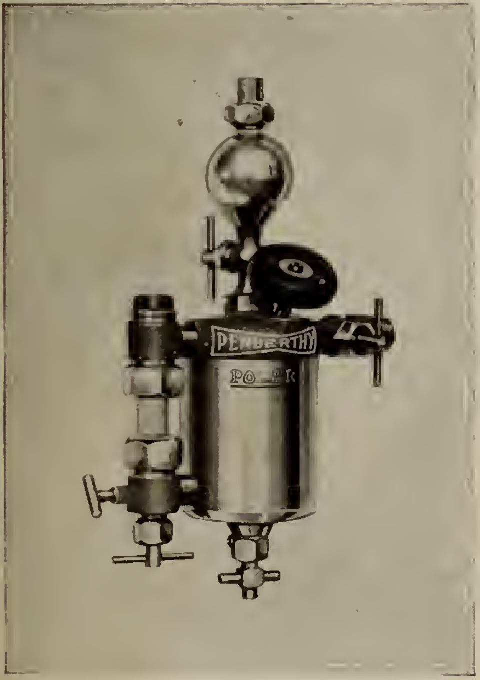
THE NEW COLD WEATHER CUP

Equipped with Special Heating Chamber. Oil Always in Liquid Condition.

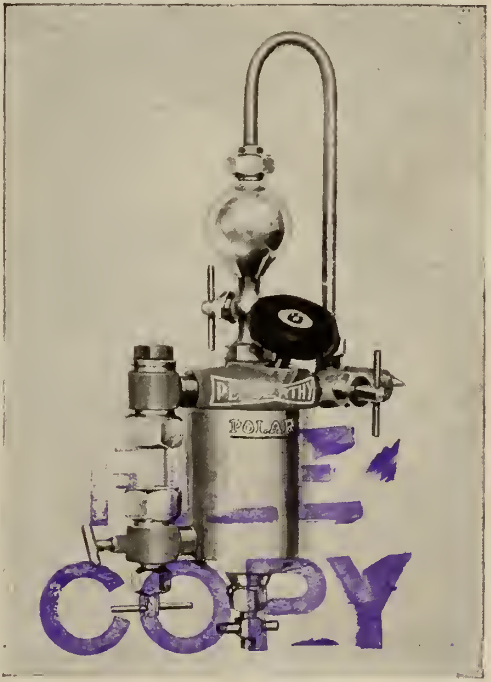


Double Connection

POLAR

Lubricators are designed along the same high-grade lines as the most expensive cups, and are equipped with a long-sight feed glass which shows the engineer at a glance the exact amount of oil being fed to the engine.

On account of the special heating chamber located in the oil reservoir, they make an ideal outdoor lubricator in cold weather.



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For a General Purpose Lubricator They Have No Equal

MANUFACTURED BY

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assures SECURITY

in the fullest sense of the word, for with it in your pipe lines—in fact, with it in practically every joint where reliable sheeting is needed—you are positively SECURE from losses of production due to shut-downs, etc.,

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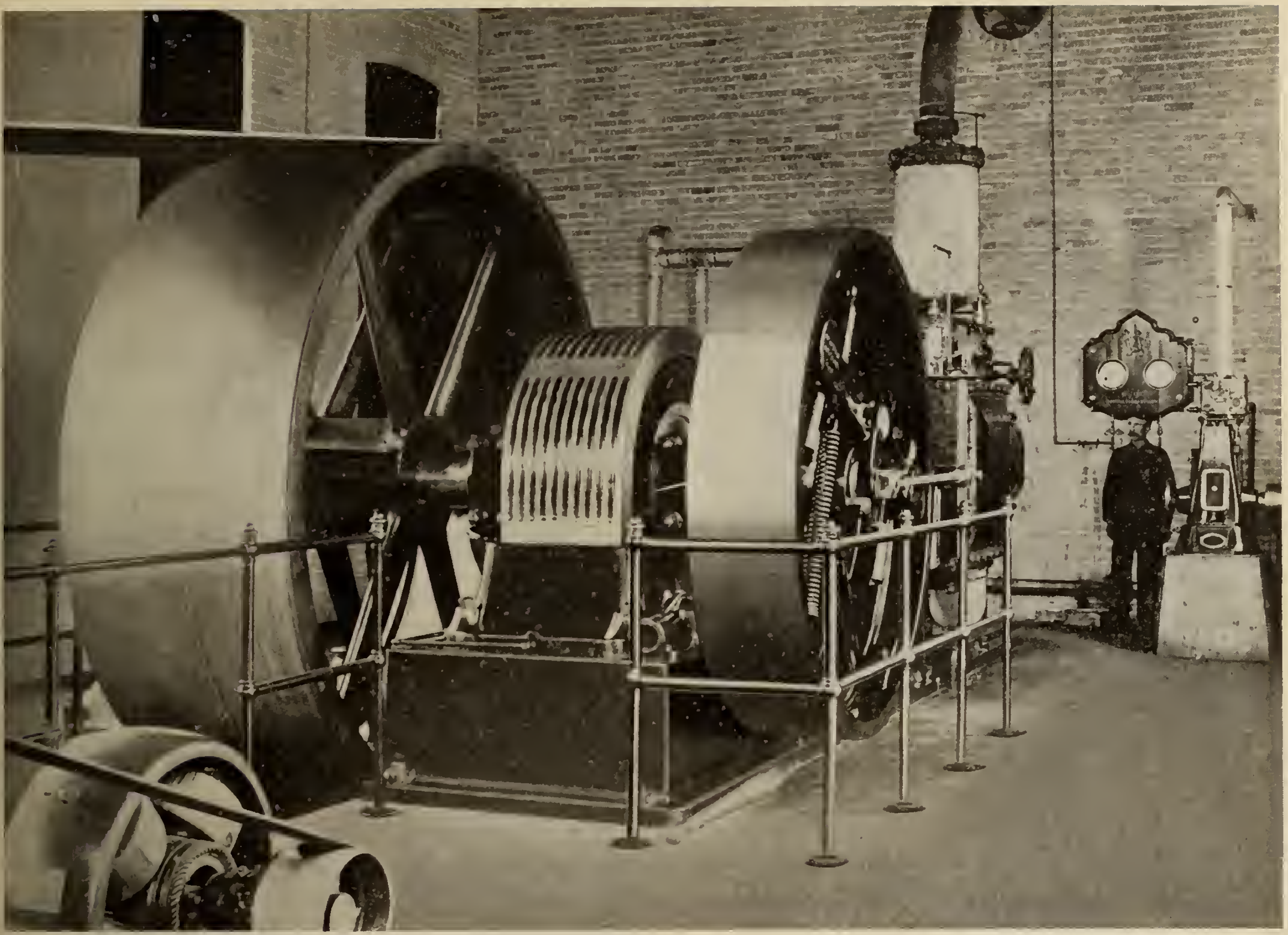
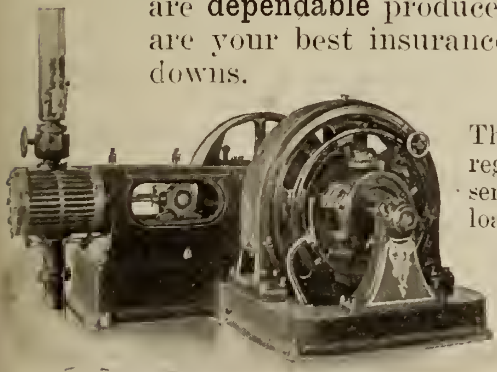


An Isolated Plant — Where Power Is Sure

There are no shut-downs because "the juice is off," or because "the wires are down" with a McEwen-equipped Isolated Plant supplying the power.

McEWEN HIGH SPEED AUTOMATIC ENGINES

are **dependable** producers of continuous electric light and power. They are your best insurance against costly repair bills and unexpected shut-downs.



They operate quietly and smoothly, with an exceedingly close regulation under fluctuating loads. Sturdiness and large reserve capacity enable them to respond instantly to heavy peak load demands.

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Built to Perform the Utmost in Boiler Duty

Flange quality steel, conforming to Manufacturers' Standard Specifications, is used in shell and heads. The tubes are lap-welded or seamless steel of standard gauge and make; the rivets are of special quality steel, and the stays are steel, without welds.

This construction is carried on with scrupulous care at every step, which is a good reason for our claim that **JENCKES BOILERS MINIMIZE STOPPAGE FOR REPAIRS.**

We invite your inquiries. Estimates and quotations promptly furnished.

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We have said big things

re the service-giving qualities of

"Hoyt Frost King" Babbitt Metal

Why shouldn't we when our customers everywhere comment on its wonderful ability to withstand heavy duty?

We feel doubly sure that a trial will result in adding you to our long list of steady customers. Make it now.

Order from your dealer; if he cannot supply you we will be pleased to make you a shipment of a twenty-five box.

"Hoyt Frost King" gives extraordinary results for all classes of **Stationary Engines**, pumps, rolling mills, pulp machinery and planing mills.

For babbitting dynamos and motors we strongly recommend our "Nickel Genuine."

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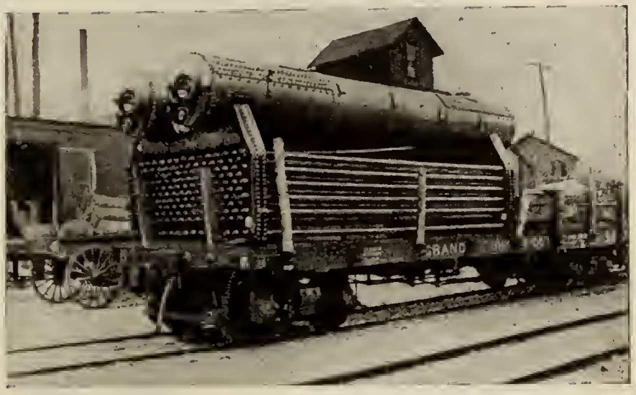
We Build:

WATER TUBE BOILERS like this



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And ALL KINDS OF TANKS like this

Also all kinds of Marine Boilers, Land Boilers, Plate Work, etc.

Send us your specifications and blue prints.

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SHIPBUILDERS, ENGINEERS AND BOILER MAKERS
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Potato Scale Powder Boiler Cleanser

Makes and Keeps Boilers New in Efficiency and Economy

You cannot afford to let scale accumulate in your boilers because it reduces their efficiency, which means a larger amount of fuel is needed to produce desired steam pressure.

Your boilers will be clean all the time if you use a small quantity of Potato-Scale Powder in your feed water daily—there will be no foaming, pitting or any other troubles due to impurities in the feed water. **Potato Scale Powder Boiler Cleanser** is made to suit your feed water conditions, and contains nothing injurious to tubes or fittings.

Sold under a positive guarantee. **Try a barrel.**

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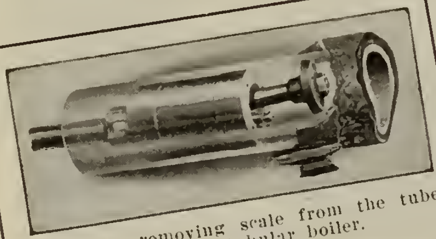
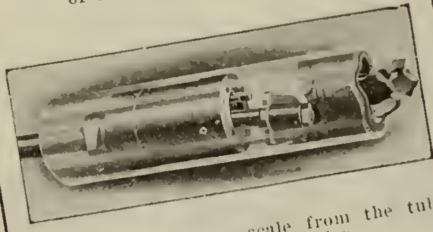
DEAN BOILER TUBE CLEANER

for increasing steam production



The Dean removing scale from the tube of a return tubular boiler.



The Dean removing scale from the tube of a water tube boiler.

Scale lowers the steam producing capacity of boilers, besides doing serious damage to the tubes.

Scale also has a direct bearing on coal consumption, because the more scale that accumulates on the tubes, the more coal there is needed to generate a given amount of steam.

Hence, to get every bit of the scale off the tubes—and keep it off—should be the first consideration of every engineer worth his salt.

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Dean cleaned tubes permit all the heat from the fire to come into direct contact with the water, thus insuring the greatest possible steam production.

The DEAN CLEANER will be sent anywhere in Canada for free trial — entirely without obligation to purchase, or any other "strings." Just write "Send Dean for free trial at once," and give size of tubes and type of boilers.

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will revolutionize boiler-room practice

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Perolin, the Boiler Metal Treatment is not a compound. It has no chemical action upon water or scale. Its affinity for the hot-plate draws it to the metal surfaces of the boiler which it coats with a liquid preservative, heat-conducting film to which scale-forming sediment cannot adhere. It will remove all scale from any boiler and thereafter positively prevent further scale formation.

Over 30,000 power plants use it exclusively—and they have clean boilers.

Perolin is superseding all other methods for the elimination of scale because it acts mechanically, and gives results not possible by any other method. It is sold under positive guarantee to end scale trouble regardless of feed water conditions and it makes good or costs you not one cent.

If you are willing to be shown say so on a post card.

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Your Boilers

are subject to great injury from the action of the water used as a boiler feed supply. If it forms scale, the boilers are hindered in the generation of steam, and your fuel bill is greatly increased. At the same time there is danger of overheating and bagging of the tubes and shell plates, likewise corrosion and pitting beneath the scale.

Many waters that do not form scale have intense pitting and corrosive action, and others cause foaming.

Dearborn Treatment

made in each case to meet conditions shown by analysis of the water used, contains reagents for all of the injurious mineral salts in the water, and prevents all of these troubles. The introduction of Dearborn Treatment in your plant will bring about a marked reduction in your fuel bills, greatly lessen your repair expense, eliminate the loss of time while shut down for repairs and scale removal, and keep your boilers in good condition at all times, capable of producing full horse-power.

Gallon sample of the water is required for analysis, taken after passing heater, if one is in use. Also description of plant.

Dearborn Chemical Company of Canada
LIMITED
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THE simple matter of buying goods at one price and selling at another never made a successful business. The *Element of Service* is what adds permanence to any organization, and the success of such organization is measured only by its ability to serve. The factor of *SERVICE*—to the customer—always has been, and is, what has guided us in making connections with manufacturers of power plant specialties.

WE have had many years' experience solving difficult power plant questions, of all kinds and conditions, and the benefit of this experience is yours in dealing with us. If your conditions are not suitable for equipment supplied by us, we do not hesitate to advise what we think will overcome your difficulties.

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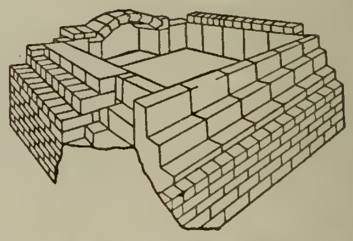
Any Handy Man Can Renew These Blocks Without

Disturbing the Other Brickwork

Think what that means in time and labor-saving, in your own plant.



Gates Boiler Furnace

Patent Applied For

This furnace will last three times as long as ordinary good fire-brick. The blocks are interlocking, and can be renewed at any time, very easily. The arch is also interlocked.

Write us for particulars and names of satisfied users. You will serve your own purpose by learning about this furnace even though you are not ready to instal it.

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382 St. James St. MONTREAL P.Q.

WHY put in another boiler

WHEN you can increase your present steaming capacity to 200 and even 300% of the normal rating of the boilers without injury to the boilers by installing a

COPPUS TURBO BLOWER

You will have all the steam you want all the time. Hundreds of satisfied customers will attest to this. No drop in steam pressure when a heavy load comes on and you can laugh at the weather man, as you can dispense with him for your draft. Besides, the blower will pay for itself in a short time, as it will burn cheaper fuel.

Cut out this Ad., put your name and address on the margin, and mail to us. Without further trouble you will get all the particulars.

500,000 H.P.

in boilers equipped with Coppus Turbo Blowers in four years.

The Coppus has replaced a great many other blowers, but no other blower has ever replaced a Coppus.

Coppus Engineering & Equipment Company
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Canadian Sales Agents:
H. L. Peiler & Co., Montreal and Toronto.

Bundy Steam Traps

When you get heat into water, keep it there! Keep it there and hold it there as long as possible, no matter where the water goes. This is the idea which the makers of the

BUNDY STEAM TRAPS

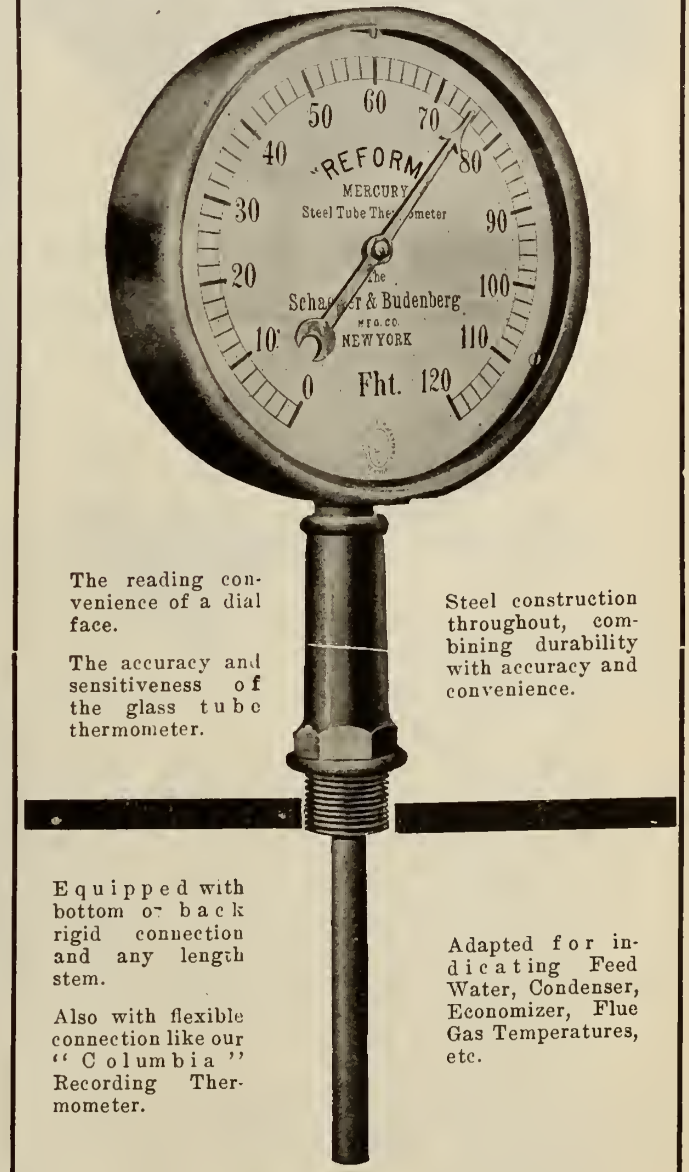
have been driving home to power plant men for years.

BUNDY STEAM TRAPS
combine Power, Simplicity and Efficiency

Nashua Machine Company
Manufacturers
Nashua - New Hampshire

H. L. PEILER & CO.
380 St. James Street - - Montreal
Are Our Agents in Canada

"REFORM" Mercury Actuated Dial Thermometer



The reading convenience of a dial face.

The accuracy and sensitiveness of the glass tube thermometer.

Steel construction throughout, combining durability with accuracy and convenience.

Equipped with bottom or back rigid connection and any length stem.

Also with flexible connection like our "Columbia" Recording Thermometer.

Adapted for indicating Feed Water, Condenser, Economizer, Flue Gas Temperatures, etc.

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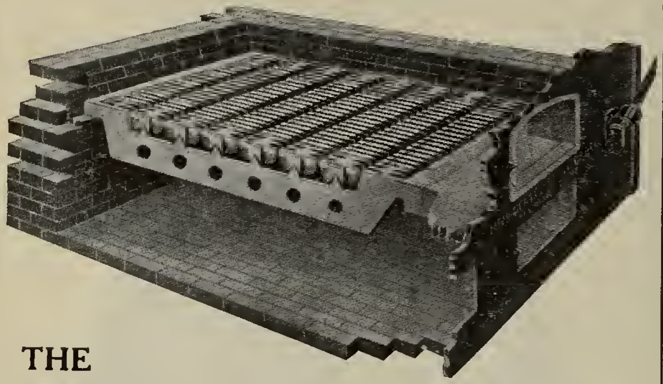
THE Schaeffer & Budenberg MFG. CO.

Makers of "Columbia" Recorders, "Crescent" Thermometers, S & B Gauges, Tachometers, Counters, Calorimeters, Indicators, etc.

Berry and South 5th Streets, Brooklyn, N. Y.
Also Chicago, Philadelphia, Pittsburgh.

Unique in Fuel Economy and Durability

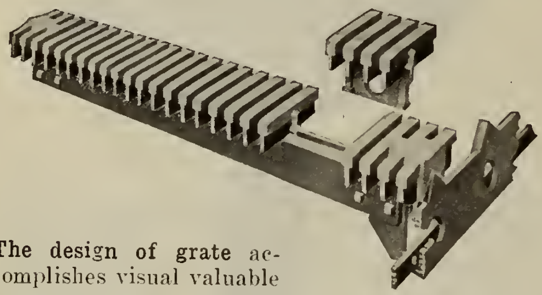


THE

The McNaughton Grate

revolutionizes the cost of power

Single Bar with section removed



The design of grate accomplishes visual valuable improvements at once, the most important being the immense draft which provides an uninterrupted air gap extending the whole width or length of the furnace; (no other grate could possibly have draft area and leave any metal to support the fuel).

There is room for expansion between each section and no part of the bar is ever under any heat strain which in other grates weakens the metal in heat resistance as well as causing buckling. With the cause of trouble removed by correct design, the McNaughten Grate will endure the most severe use without sagging or buckling if given proper care.

The whole set of grates and frame-work is self-contained and will fit where ordinary grates have been removed. Method of construction makes **REPAIRS EASY.**

It will pay you to take advantage of our 30 days' FREE TRIAL OFFER. If at the end of this period you are not satisfied that it's a good investment, we will remove the grates without cost or inconvenience to you.

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There's science in it

Every part of a "Bennis" Stoker is designed on scientific lines, to do what it has to do in the most perfect manner possible. Success is proved by numerous installations.

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"MR. OWNER," said the Architect to his client, "the walls and floors of this building of yours will be concrete—and they will be waterproof, too. I have specified

R.I.W. TOXEMENT

REMEMBER ITS WATERPROOF
REG. U.S. PAT. OFF.
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R.I.W. Toxement is a dry powder, added in small quantities to the Portland Cement. It lubricates the concrete and waterproofs it against the fiercest driving storms—even against water pressure.

It waterproofs reinforced concrete factories, piers, bulkheads, chimneys, tanks, dams, bridges, walls, etc., etc.

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Manufactured in Canada by

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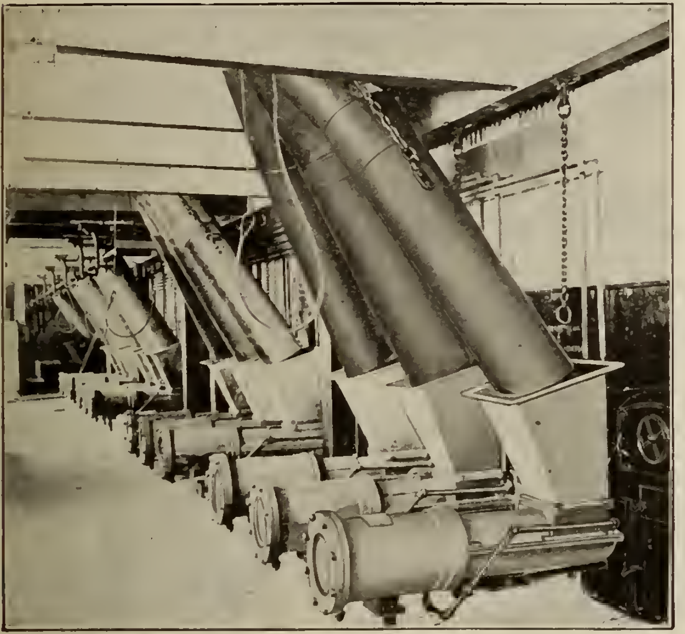
TORONTO, ONTARIO, CANADA

When Labor is Scarce, Expensive and Unskilled—

Install



Jones Underfeed Stokers

What the old hand-fired method is costing you will soon pay for **Jones Underfeed Stokers** plus fuel saving and better results.

HUNDREDS OF THEM ARE EFFECTING SAVINGS FROM 15% TO 25% IN PLANTS LIKE YOUR OWN.

Simplest stokers built; no parts moving in contact with fire, no losses through grate bars, no smoke.

Write for descriptive catalogue.

JONES UNDERFEED STOKER COMPANY, LIMITED
National Trust Building, Toronto

OTIS HORIZONTAL STORAGE HEATER

Laundries, Dairies, Hospitals and Hotels are a few of the institutions where the **"OTIS"** is necessary and economical, and you should consider this along with its other improved features. 1—Can be supplied with either exhaust or live steam. 2—Fitted with a closely adjusted regulator. 3—Tubes can be readily withdrawn from the body of the heater. 4—A double set of heating tubes, one for exhaust and one for live steam.

But write us or our agents for full particulars, please.

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Canadian Agents:
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838 Dundas Street, Toronto, Canada.

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Shipped from Hamilton, Ont. **Let us give you complete information**

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"INVINCIBLE"
Mechanical Lubricator

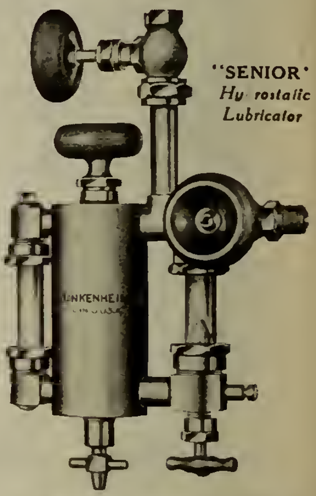
on every subject will always exist. Whatever your opinion may be as to the best method of Engine Cylinder Lubrication, —whether it be Hydrostatic, Gravity or Mechanical, the efficiency of the installation will be greatly enhanced by the use of a

LUNKENHEIMER
Cylinder Lubricator

From the extensive line can be found a type to meet your every need. They can be finely adjusted, are positive in operation and very durable.

The HYDROSTATIC type is made with both single and double connections, Bronze Body; the GRAVITY type with Bronze or Glass Body, one, two or three feeds, and the MECHANICAL type with from one to four feeds, capacities 1 qt. to 1 gal.

Let us help you choose the type best suited to your individual case. Write for descriptive literature.



"SENIOR"
Hydrostatic Lubricator

THE LUNKENHEIMER CO.
"QUALITY"
Largest Manufacturers of High-Grade Engineering Specialties in the World
New York Chicago **CINCINNATI, O., U.S.A.** Boston London

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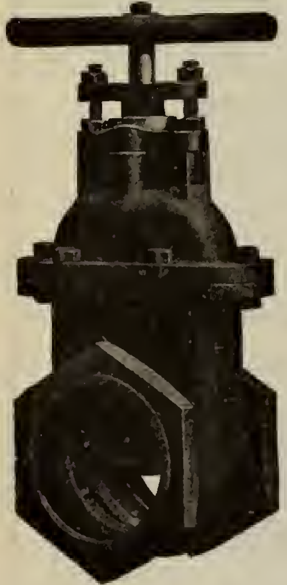
KERR
("New KEYSTONE" Pattern) GATE VALVES



If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the " Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

JENKINS BROS'

Type "K" Gate Valves

Wherever quality is the predominant factor, these valves have won out against the keenest competition.

They give the maximum in service value.

That is why they are exclusively installed on the exhaust, heating and water mains in most of the largest and finest buildings in the World to-day.

These valves are of the double-wedge type with bodies moulded to a globe shape to insure the greatest possible strength and rigidity. All parts are interchangeable. Made either inside screw—stationary spindle or outside screw and yoke—rising spindle in screwed and flanged patterns.

Reuglarly furnished in brass ¼ in. - 3 in., inclusive; and in iron body from 2 in. to 18 in. inclusive.

When desired we can also equip them with spur or bevel gearing, extension stems, chain wheels, indicator posts and floor stands.

Write for Catalog 8.

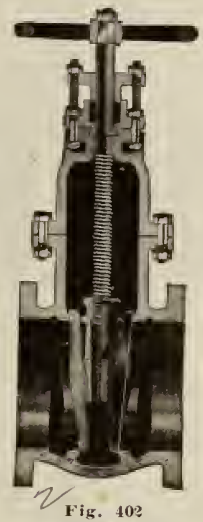


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Fig. 402
Sectional View

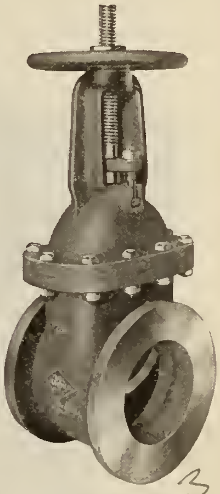

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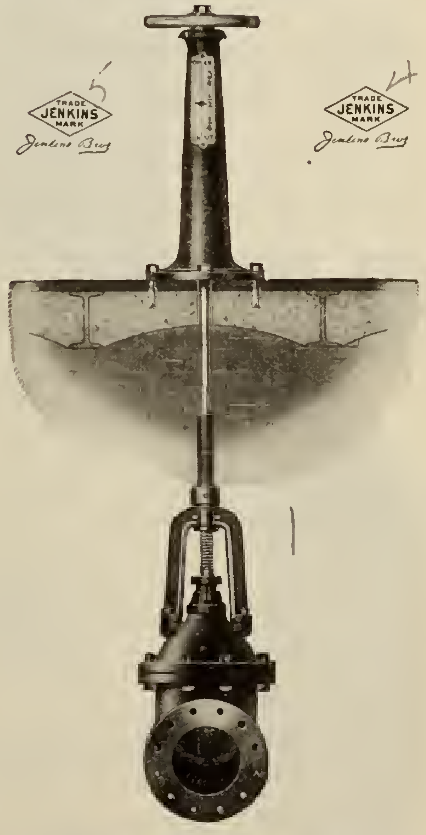
Fig. 404
Outside View

5

4



1

Fig. 391
Floor Stand with Indicator showing Extension Spindle attached to Type "K" Gate Valve, with Rising Spindle.

SOLE MANUFACTURERS

JENKINS BROS., Limited

103 St. Remi Street **MONTREAL**

6 [illegible]

UNEQUALLED WORKMANSHIP
HIGHEST EFFICIENCY
COMPLETE SATISFACTION

ESCHER WYSS & CO.

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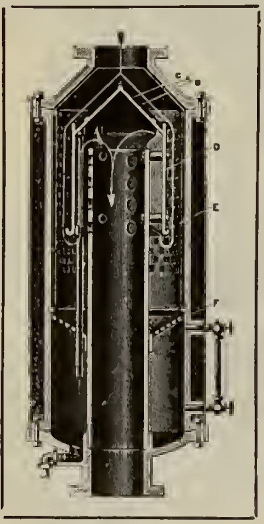
TO CONSIDER ABOUT
A SEPARATOR.



I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

SWEET'S SEPARATORS.

DIRECT SEPARATOR COMPANY
820 Geddes Street - SYRACUSE, N. Y.

General Sales Agents:
Canadian Fairbanks-Morse Co., Limited, St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Vancouver, Victoria.

All the Details of Safety
Economy and Efficiency
are embodied in

"Homestead" Quarter Turn Valves

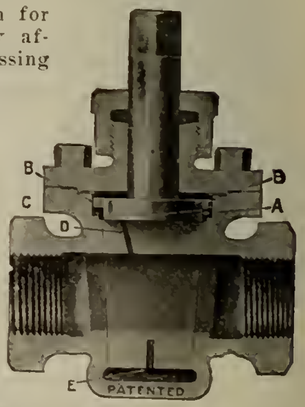
They open and close easily. The patented balancing parts insure this valve against sticking.

When the Homestead Valve is fully opened the two surfaces which are depended upon for tightness are in no way affected by the material passing through.

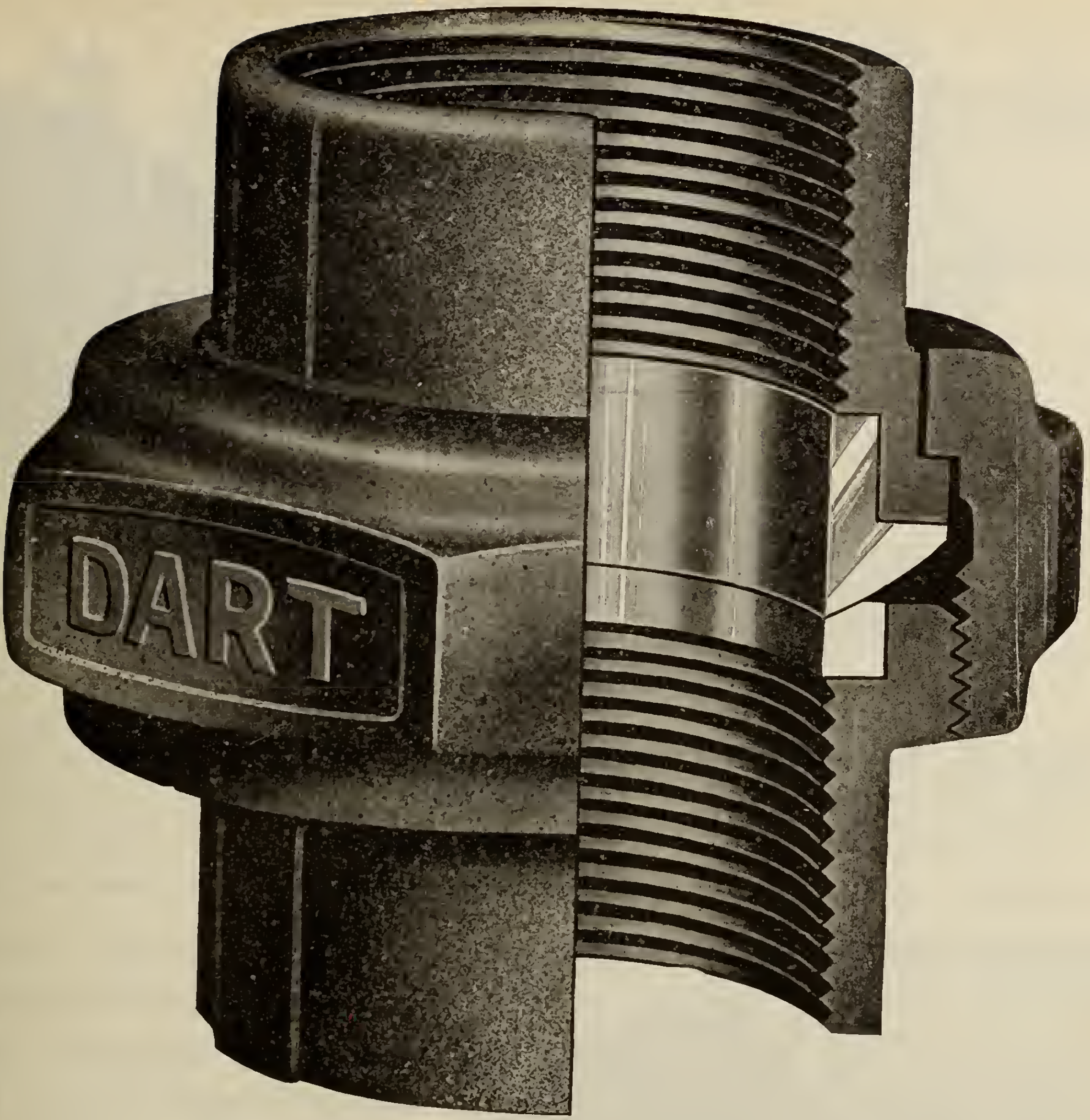
The plug cock provides a straight-way opening, which is desirable in all sorts of work, but is particularly important in high-pressure service. It is very useful when thick, heavy liquids are handled.

Among users are the largest mills, mines and railroad companies.

It will pay you to try them.



Homestead Valve Manufacturing Co.
PITTSBURGH, PA.
Works: Homestead, Pa.



DART UNIONS

2—Two Bronze Seats—2

Prevent Corrosion

Malleable Iron Pipe Ends and Nut Insure Strength and Durability

THESE two points are essential to make perfect and lasting joints.

Twenty-four years of successful record is your guarantee of the Dart construction.

DART UNION CO., LIMITED
TORONTO, CANADA

Higher Efficiency is the by-word of every manufacturer to-day

and in order to obtain the highest efficiency from each square foot of heating surface in your plant it is necessary to deliver live, hot, dry steam to the different steam using apparatus and keep it dry by removing the condensation as fast as it accumulates.

The Anderson Model "D" is the Logical Steam Trap

as it works continuously and automatically. The valve and seat are sealed with at least three inches of water at all times, thus eliminating the possibility of live steam escaping with the condensation.

At this point the question may naturally arise in your mind, "Where and under what conditions can the Anderson Steam Trap be used?" The Anderson Model "D" Trap can be used on any apparatus using steam at pressures varying from 250 pounds to gravity, and also where there is condensation in air lines. We have not sufficient space in this book to enumerate the many places and conditions under which the Anderson Trap is working successfully, but suggest if you have a condition which requires the elimination of condensation we will be pleased to confer with you and our experience may assist in solving the difficulty.

One of the prominent features of the Model "D" Trap is the ease with which the valve and seat can be changed to accommodate the varying pressures at which you may desire to operate the trap. For example, should you have a trap fitted to work from 150 pounds down and wish to change it to work from 30 pounds down, it is only necessary to specify a valve and seat of the desired pressure which can be installed in less than five minutes without removing the trap from the line.

All parts are accurately machined to solid gauges and can be replaced at any time, as every part is made interchangeable.

Our new catalog is just out. Send for a copy.

The V. D. Anderson Co.
1935 West 96th Street
Cleveland, Ohio

Condenser and Receiver *for receiving and discharging condensation to trap above boilers.*

Return Trap above boilers *for feeding the condensation to the boilers.*

"— 15% Fuel Saving over old style Pump and Receiver System — getting *better* heat for drying purposes."

says the management of The Cook Pottery Co., of Trenton, N. J.

IT is the same story told by every user of the

Morehead Back-to-Boiler SYSTEM

More often the reported results are beyond belief considering the simplicity of the "Morehead" System.

You can do the same thing or better in your plant. Full information without obligation furnished on request.

The success of the "Morehead" System makes interesting and instructive reading for every progressive, thinking engineer. 376

Canadian Morehead Manufacturing Co.
Woodstock **Dept. "J"** **Ontario**

Money Saved—Work Made Easier

Considerable money can be saved and the engineer's work made much easier if the correct method of handling condensation in the boilers be adopted.

There are three things which are desirable in a device of handling the condensation.

1. It shall remove the condensation so efficiently that the boiler tubes shall be free for the live steam.
2. There should not be any stop-cocks to open, any engine to watch, any pump to keep oiled. It should be absolutely automatic so that the engineer shall be free to attend to other duties.
3. It should return the condensation to the boiler at as near the boiling point as possible, so that use is made of every available heat unit.

The "Detroit System" offer a positive method of removing the condensation from boilers and returning it at a temperature but a couple of degrees below the boiling point.

The "Detroit System" is absolutely automatic and it uses up no power in returning the water to the boilers—a big advantage over the pump and receiver method. Moreover, the water is returned directly to the boiler without giving it any time to cool.

The engineer who works for his employers' best interest will recommend the "Detroit System" as it saves many hundreds of dollars yearly in fuel.

Some one of the "Detroit Systems" will solve any problem in handling condensation ever encountered in actual business practice.

Write for full information on the "Detroit System" for handling condensation. It is found in Steam Trap Book No. 14-A.

CANADIAN *Sirocco* COMPANY

LIMITED

WINDSOR, ONTARIO.

(5)

SALES OFFICES

S. S. Clarke,
605 2nd St.,
Calgary.

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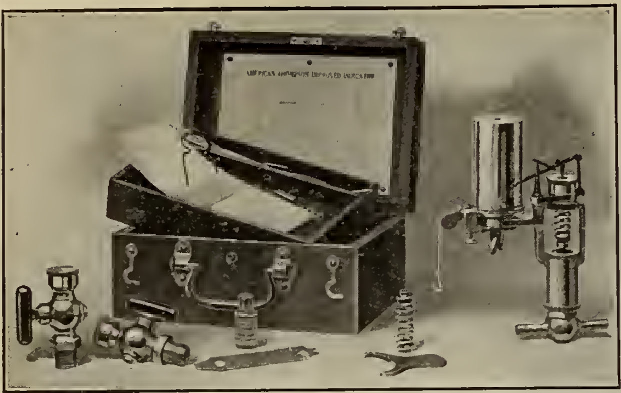
Montreal.

W. W. Hicks,
567 Banning St.,
Winnipeg.

Canadian Steam Specialty
Sales Co.,
526 Traders Bank Bldg.,
Toronto.
Phone Main 5118

Canadian Sirocco Company, Ltd.,
604 Credit Foncier Bldg.,
Vancouver.



WHY WAIT ?

Begin NOW to learn all about Steam Engine Indicating. THE AMERICAN-THOMPSON IMPROVED INDICATOR will help you—as it has helped others—to master every problem of your engine room and—what is also important—to help you EARN MORE MONEY.
Our EASY PAYMENT PLAN gives you immediate use of the Indicator.
Write for details.

Selling Agents for Canada: THE CANADIAN FAIRBANKS-MORSE CO., LIMITED, Montreal, Toronto, Winnipeg, Calgary, Vancouver, St. John

American Steam Gauge & Valve Mfg. Company

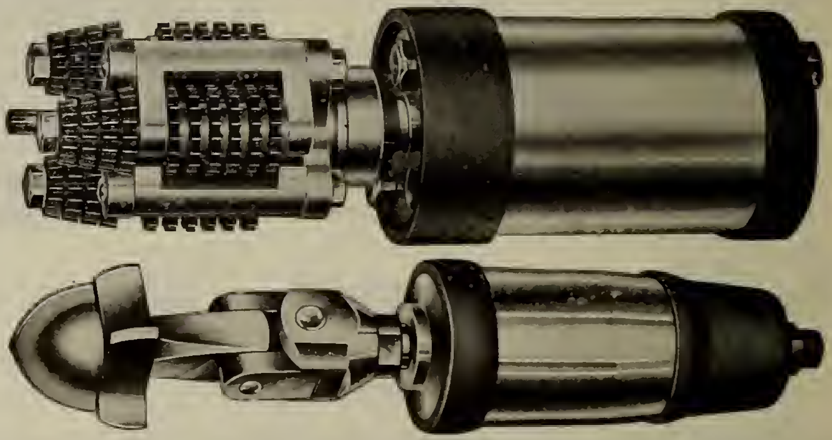
New York Chicago BOSTON Atlanta Pittsburgh

ROTO TUBE CLEANERS

Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.
The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.

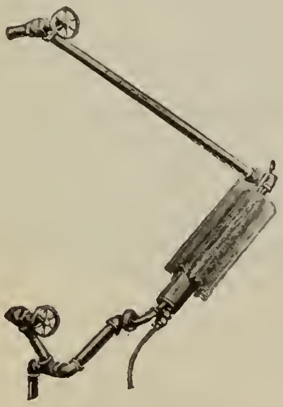
THE ROTO COMPANY
Write for Catalog HARTFORD, CONN.



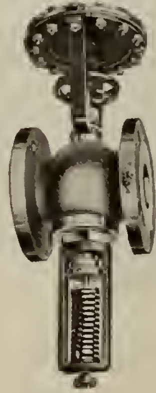
Mechanical Regulation of Boiler Feed Water

By the use of the "S-C" method you are assured of a continuous feed at all times load is on boiler. The graduation in rate of feeding is entirely dependent upon the load and fire conditions. The Regulator will carry a constant level on steady load—higher level on light load and lower level on peak loads. Variation in water level is entirely dependent on inclined position of generator which is adjustable while operating under full load.

Bulletin No. 21 explains all.



Generator or Actuating end of Regulator.



Regulating Valve Placed at Any Point, Any Position.

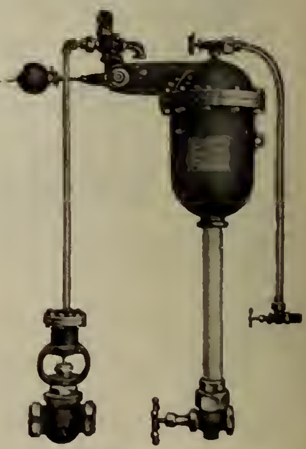
The "S-C" Regulator Company
FOSTORIA, OHIO, U.S.A.

No Troublesome Floats

The Vigilant Feed Water Regulator has no floats in its construction, for the best of floats, with all their guarantees, will leak and become water logged or collapse, in spite of all arguments to the contrary. Under heavy pressure the water seems to penetrate the pores of the metal. The Vigilant has no floats, no diaphragms, no complicated system of levers and small valves, no concealed or obscure steam passages.

Write for Description

The Chaplin-Fulton Manufacturing Co.
28 Penn Ave., Pittsburgh, Pa.



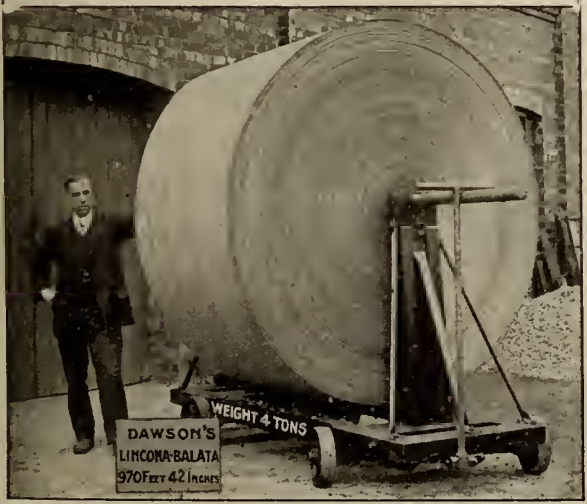
It's the grip that counts.

"Lincona"

Balata Belting

Manufactured by
James Dawson & Son
Limited
Lincoln, England

The Belt with a Grip and which gives the maximum transmission of power.



Is used and is giving every satisfaction in all parts of the world — in **Engineering Shops** for **Machines,** Dynamos, Fans and Main Drives; in **Laundries, Sawmills, Dye Works, Cotton** and **Woollen Mills, Flour Mills** and **Warehouses** as **Elevators** and Conveyors for gain, coal, sand, rock, ore, etc.

North, South, East and **West** will be found this well-known brand. Output capacity 60,000 feet weekly, and more to follow. The quality cannot be surpassed because the materials used are the best—best cotton, best balata, and in every way

BRITAIN'S BEST

production of its kind.

Lincona Balata Belting is the strongest belt made. Breaking strain 11,700 pounds per square inch.

What Balata is:

A natural gum product which is of exceptional strength and durability, being the most powerful adhesive substance. It is thoroughly waterproof and can be used and exposed under every condition of weather, and, if necessary, can be run in water without trouble or injury.

Avoid imitations—there are other so-called Balata Beltings, but **Lincona** is in a class by itself.

Lincona improves with age.

The Canadian B. K. Morton Co., Ltd.

49 Common Street
MONTREAL

86 Richmond St. E.
TORONTO

Austen Bros., Ltd., Halifax, N.S. Sherwood & Fraser, Ltd., Winnipeg, Man. Western Oil & Supply Co., Vancouver, B.C.

A SPARTAN is the first belt to operate successfully what is considered the hardest quarter-turn drive in the State of Washington. It is a high-speed drive with only five feet between pulley centres. The belt makes two quarter turns and is called upon to drive the entire planing mill. Previous belts slipped, burned, and soon played out. Spartan has already outlasted any former belt; it runs perfectly true, does not slip and is still in excellent condition.

SPARTAN
LEATHER BELTING

because of its strength, pliability and pulley grip is particularly adapted to the most difficult drives in your plant. Spartan-equipped drives insure greater production and less cost for operation.

The Graton & Knight Mfg. Co.
Oak Leather Tanners and Belt Makers
WORCESTER, MASS.

Representatives in Canada:
THE CANADIAN FAIRBANKS-MORSE COMPANY, Limited.
St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.

"Consult our Engineering Department in connection with your Transmission Problems."

DONOVAN LUMBER COMPANY
FIR, SPRUCE AND CEDAR LUMBER

ABERDEEN, WASH October 15, 1915.

The Gretcn & Knight Mfg. Co.,
Seattle, Wash.

Gentlemen:

In reply to your query of recent date regarding service rendered by the 14" Spartan Double Belt you installed on our quarter turn drive, we wish to say the belt has been entirely satisfactory, and owing to its extreme pliability and friction we feel we have at last secured the right kind of belt for this particular drive.

Yours truly,
DONOVAN LUMBER COMPANY.
By

Mention this paper when writing advertisers. It will identify the proposition about which you require information.

NOTE THE SIGN ☛

Photo of Our Booth at the

C.A.S.E. Convention

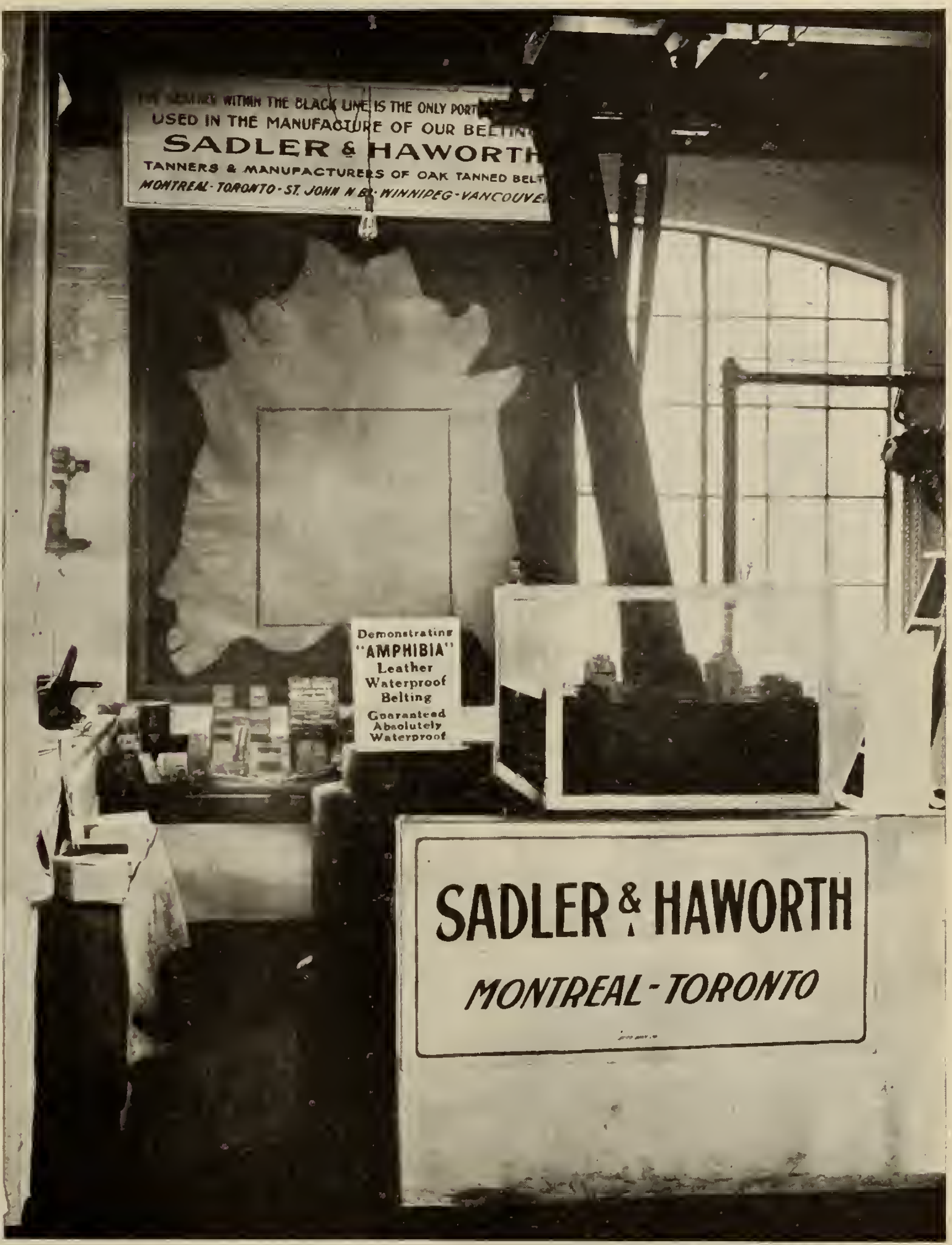
Showing our

AMPHIBIA BELTING

"running in water"

"Amphibia" is absolutely waterproof. It is giving first-class service to-day in some of the wettest plants in Canada. Saw Mills, Steam Laundries, Cement Plants, Pulp Mills and other places where moisture is plentiful will find "Amphibia" the very best belting to use.

"Amphibia" Belting costs less per day of service, simply because more is put into the making, more care in selection of hides, more care in tanning, more care in the butts used for this brand, more care in cutting, stretching, splicing and trimming. All this extra money spent on the making insure longest life and less cost per day of service.


WITHIN THE BLACK LINE IS THE ONLY PORT
USED IN THE MANUFACTURE OF OUR BELTIN
SADLER & HAWORTH
TANNERS & MANUFACTURERS OF OAK TANNED BELT
MONTREAL · TORONTO · ST. JOHN N.B. · WINNIPEG · VANCOUVE
Demonstrating "AMPHIBIA" Leather Waterproof Belting Guaranteed Absolutely Waterproof
SADLER & HAWORTH
MONTREAL - TORONTO

First cost is not the correct standard of your belting costs for any period, because one belt which costs you less per foot to buy may only run half as long as another belt which may have cost you 10% more when new. Recommend "Amphibia" for your plant and your purchasing agent will credit you with saving a lot of the firm's money. Try it.

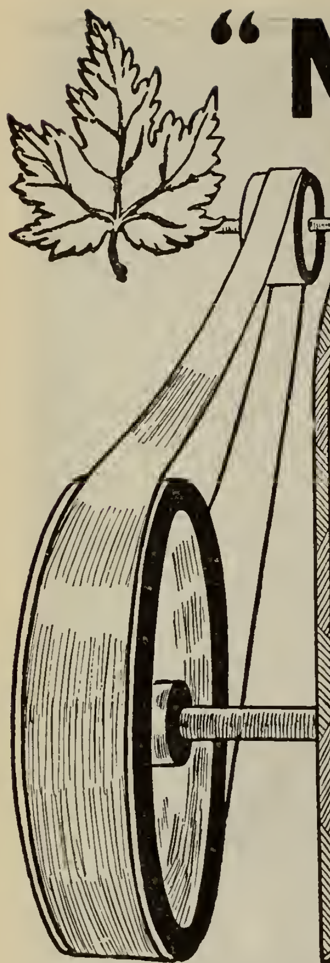
Costs Less per day of Service

Sadler & Haworth

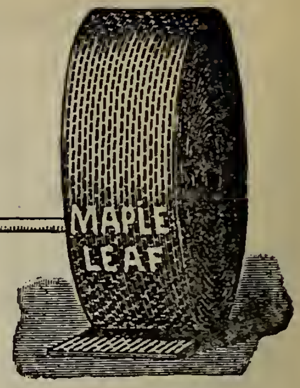
Tanners and Manufacturers

Montreal—511 William Street. St. John, N.B.—89 Prince William St. Toronto—38 Wellington St. E. Winnipeg — Princess and Bannatyne Sts. Vancouver, B.C.—107-111 Water Street.

For Over 40 Years Makers of the Best Leather Belts.



"MAPLE LEAF"



Stitched Cotton Duck

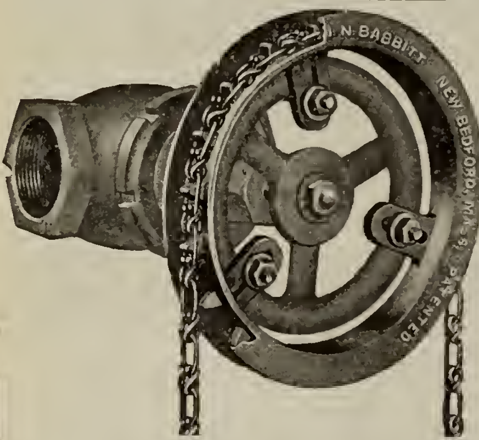
Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying. A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada



Goes Right on Your Present Valve Wheel

"Goes on" is about right, too, it's so easy to apply, and by putting a

Babbitt Adjustable Sprocket Rim

on each of those hard-to-get at overhead valves you can save a lot of time you now spend in hunting ladders and all the risk you now run in using them after you've found them. One concern that thought two would do, bought 27 in a little over two months. The price will encourage you to have enough of them.

Ask your dealer. Write for Illustrated Folder.

Babbitt Steam Specialty Co., 59 So. Water Street, **New Bedford, Mass.**
The R. E. Cleaton Co., 20 St. Nicholas St., Montreal, Que.

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form.
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.

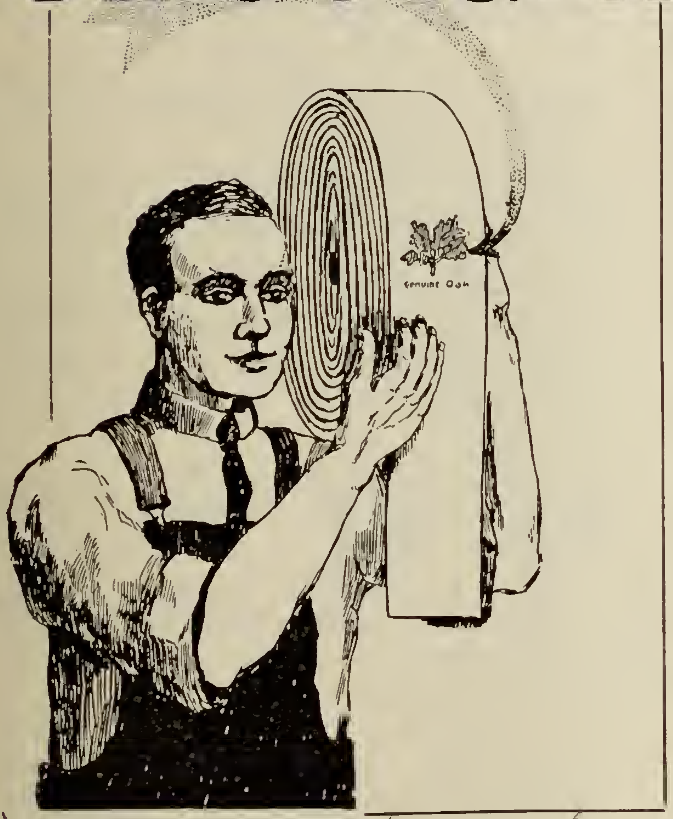
MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless

Any Quantity sent on APPROVAL

This Mark

GENUINE OAK
REGISTERED TRADE MARK



on Belting

is a warranty of long service and very small upkeep cost.

This distinguished service mark appears on every piece of

D. K. McLaren's

Genuine British Oak Tanned

Leather Belting

Cut received Sept 1 - 1916

Only flawless back leather is used and our genuine British Oak Tanning Process preserves every bit of the hide's natural strength.

Every inch of our belting is reliable, while our prices are the lowest—quality considered.

Many of Canada's largest and best equipped power and industrial plants are users.

Would you like to know the names of some of our customers?

D·K·McLAREN
LIMITED

Head Office and Factory: 351 St. James St., Montreal, P.Q.

TORONTO, ONT.
194 King St. West

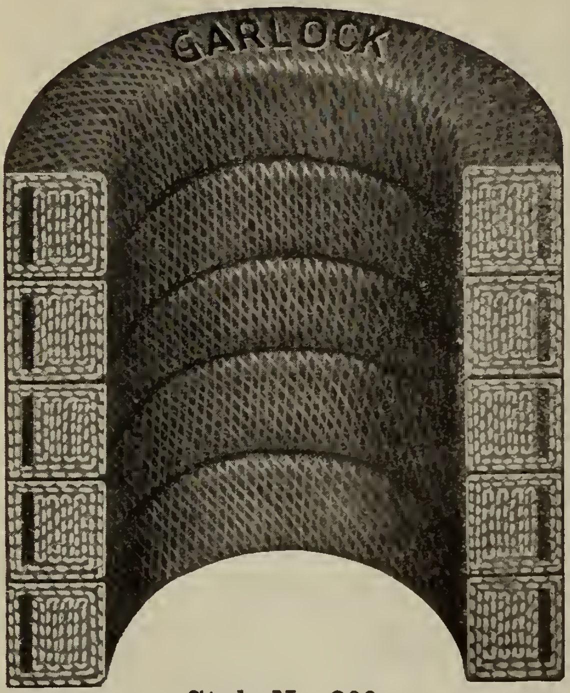
ST. JOHN, N.B.
64 Prince William St.

VANCOUVER, B.C.
847 Beatty St.

ENGINEERS SUPPLY CO., 123 Bannatyne Ave. East, Winnipeg, Man.

If any advertisement interests you, tear it out now and place with letters to be answered.

Garlock High-Pressure Piston Rod Packing



Style No. 200.

Is built up on a core consisting of several flattened tubes.

The tubes are braided from the highest grade of asbestos yarn, and are cemented together with the best rubber friction.

The tubes are cemented only on the outside, therefore the packing is lighter per linear foot than other types of high-pressure packing.

In service the tubes open under pressure and expand the packing against the piston rod.

The core of flattened tubes is backed with a cushion of high-grade rubber, so compounded as to retain its resiliency under heat.

The tube-core and rubber cushion are covered with cloth woven from the highest grade of long fibre asbestos.

Our high-pressure packing is not merely smeared on the outside with graphite and grease.

Every fibre of it is saturated with a specially prepared lubricant, which does not affect the rubber cushion or friction.

The outside of the packing is coated with the best grade of floating stock graphite.

The best materials we can buy are used in the manufacture of our high-pressure packing.

It is built up in rectangular form and uniform shape and exact sizes are thereby obtained.

Asbestos packing, which is rolled around a rubber core and afterwards distorted by running through a square die, does not retain its shape or size.

Our high-pressure packing is made by experts who have done nothing else for years but make that one type of packing.

The length of service obtained from it is greater than that secured from other makes, therefore the labor cost of applying and adjusting is less.

Our packings are sold at net weights; weights of tubes and boxes are not included.

Every pound of our high-pressure packing carries with it the Garlock guarantee of satisfactory and economical service.

We will promptly replace or refund the cost of any of our packings which may prove unsatisfactory to our customers.

The Garlock Packing Company - Hamilton, Ont.

Branches:

Montreal, Quebec - - - - 342 St. James Street
Toronto, Ontario - - - Continental Life Building
Winnipeg, Manitoba - - - - - Galt Building

Use P.P.P. for your Plunger Elevator this time

Packing for this class of service must resist pressure to hold tight, resist wear to be economical and make frequent repacking unnecessary, and it must give and take with the sway of the plunger—peculiar and exacting conditions, we grant, but every requirement is met by P.P.P.

DANIEL'S ROD PACKING

P.P.P.

FOR STEAM, AIR, WATER, AMMONIA

Reg. U S. Pat. Off.

The reason why P. P. P. is peculiarly adapted to plunger elevator service is because of its sensitiveness to pressure from any direction—top, bottom or side, or any combination of pressure.

This give-and-take principle is applied through the sliding-wedges and compressible cushion that make up the packing.

When you consider that P. P. P. automatically adjusts itself to conditions created in the stuffing-boxes of engines running at hundreds of revolutions a minute, you can understand what a comparatively easy task it is for the packing to adapt itself to the duty required in the case of an elevator plunger travelling at a fraction of the speed of an engine piston rod.

Pack your plungers with P. P. P. and you will be rid of the annoyance of leak or drip, and you'll save yourself a lot of trouble, for P. P. P. lasts.

We suggest that you write us for special directions to be followed in packing your plungers.

License Examination Book, Free

Fill out and mail this coupon. We will send you our Blue Book of Questions and Answers to Engineers' License Examinations absolutely FREE.

Your name..

Address..

Employed by..

Address..

Brand of Packing used..............................

Make of Elevator..................................

Diameter of Plunger..............................

Series 24-H

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS

PHILADELPHIA, PA., U.S.A.

High quality is being maintained in spite of war conditions

War Conditions in Canada

may have caused a shortage of asbestos, but "PALMETTO" will continue to be made only of the first grade asbestos, even though it costs more.

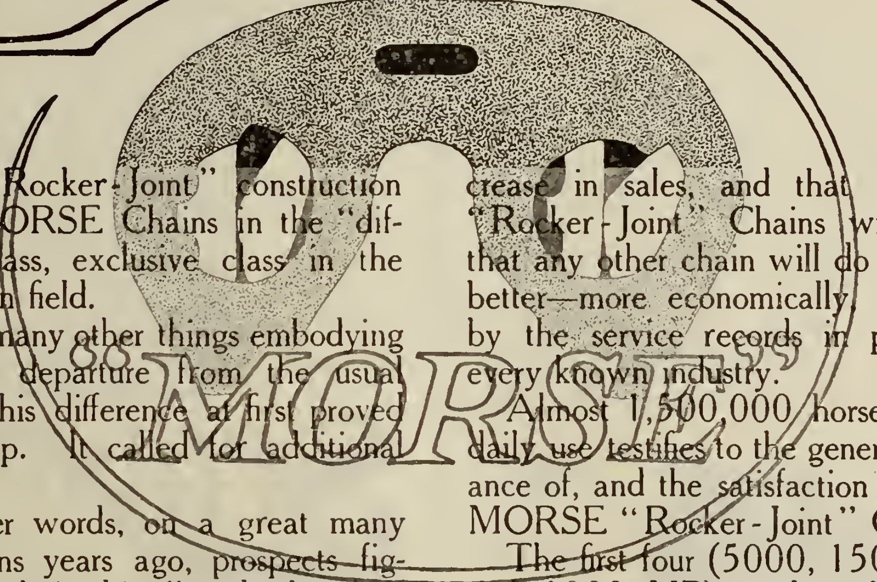
The quality that has made "PALMETTO" famous for long service under hard conditions will be continued.

Let us send you a sample to prove quality.

Greene, Tweed & Co.
SOLE MANUFACTURERS
109 Duane St., New York

CANADIAN DISTRIBUTING AGENTS:
The Canadian Fairbanks-Morse Co., Limited, Montreal, Ottawa, St. John, Toronto, Winnipeg, Calgary, Saskatoon, Victoria, Vancouver.

A CHAIN OF EVIDENCE



The "Rocker-Joint" construction placed MORSE Chains in the "different" class, exclusive class in the silent chain field.

As in many other things embodying a radical departure from the usual practice, this difference at first proved a handicap. It called for additional proof.

In other words, on a great many propositions years ago, prospects figured on "chain drive" and when half convinced that "chain drive" was a better proposition for them than belt drive or gearing, we had to show additional evidence that MORSE "Rocker-Joint" Chains — the differently constructed type, would do the work as well or better than the ordinary "chain drive."

Some prospects, we must admit, wouldn't go farther than just "chain drive", but they were not many. That we did show the additional evidence is proved by the yearly increase in sales, and that MORSE "Rocker-Joint" Chains will do all that any other chain will do and do it better—more economically, is proved by the service records in practically every known industry.

Almost 1,500,000 horsepower in daily use testifies to the general acceptance of, and the satisfaction given by, MORSE "Rocker-Joint" Chains.

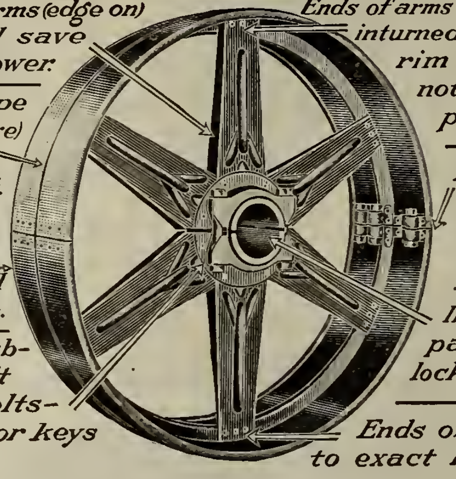
The first four (5000, 1500, 1200 and 1000 HP), and probably the first ten, largest chain drives in the world are of the MORSE type, in fact almost all chain drives over 500 HP are of this type, showing a decided preference where a large amount of money is to be invested. The same reasons for this preference hold good for the smaller drives such as ¼, ½ and 1 HP.

Literature and information will be gladly furnished free without obligation to you. Write us of your transmission problems.

MORSE CHAIN CO., ITHACA, N. Y.

MORSE--Of Course

The Most Efficient Pulley



Flat "A" braced arms (edge on) cut the air and save enormously in power.

Grooved air escape (an exclusive feature) diminishes air cushion under belt.

A rim made like a channel iron central flanges and safety beaded edges.

All steel parting hub-clamped to shaft with powerful bolts-no set screws or keys required.

Ends of arms solidly riveted to inturned strengthening rim flanges-Arms not riveted through pulley face.

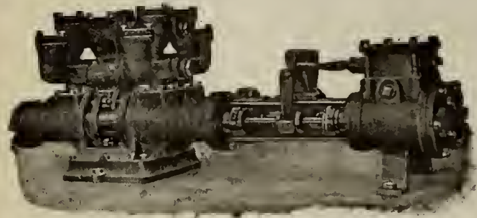
A parting pulley-no occasion to strip shaft. Rims doweled together at bead.

Interchangeable parting bushings locked to pulley hub.

Ends of arms all milled to exact length.

STUDY the chart and see why the "**AMERICAN**" is the most efficient. We welcome an investigation, and are grate our claims to the satisfaction of the engineers. There is no secret about it, and we can proveful for an opportunity to show the real facts.
Minimum belt slip—less than with cast iron or wood pulleys.
Minimum loss of power through windage. Maximum strength for least weight.
No set screws and no key ways, except in unusual cases. Interchangeable bushings.

The American Pulley Company, 4234-60 Wissahickon Ave., Philadelphia, Pa., U.S.A.
Williams & Wilson, Limited, Montreal
The A. R. Williams Machinery Co., Limited, St. John, N.B., Toronto, Winnipeg, Vancouver



HIGH GRADE PUMPS

Let us know your requirements in this line,—we can make you a most attractive proposition.

The Smart-Turner Machine Co., Limited
Hamilton, Canada

Scandinavia Belting

There are lots of drives in your plant where this belt should be placed.

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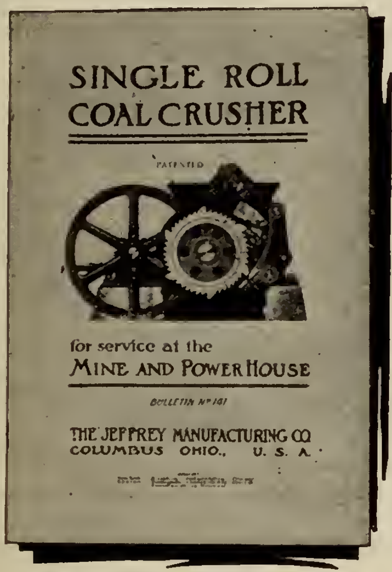

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the machine which will crush more coal with less power and expense than any other on the market.

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This book also contains many splendid testimonials from many users, as well as drawings and suggestions as to the ways in which the crusher can be installed in connection with various types of elevating and conveying machinery.

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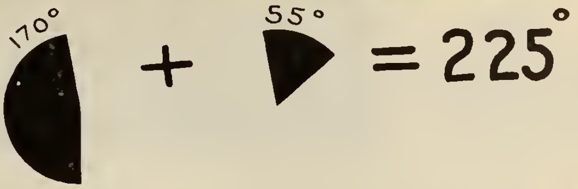
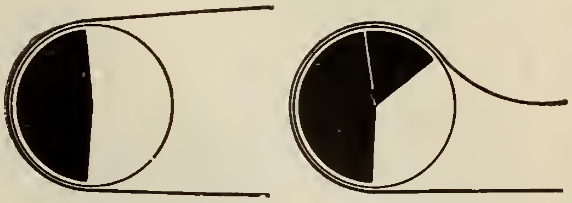


In other words this belt has (55 ÷ 170) 32.3 *per cent INCREASED PULLING ARC due to CLING-SURFACE TREATMENT*



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Cling-Surface-treated belts become impervious to moisture and steam and are not dried out by heat.

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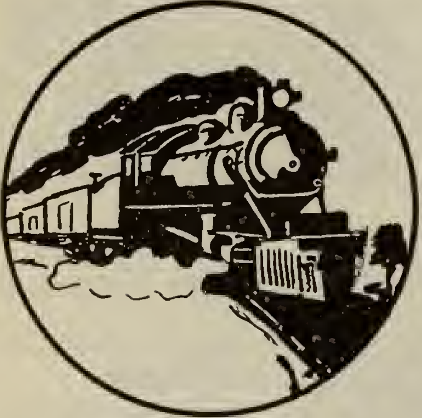

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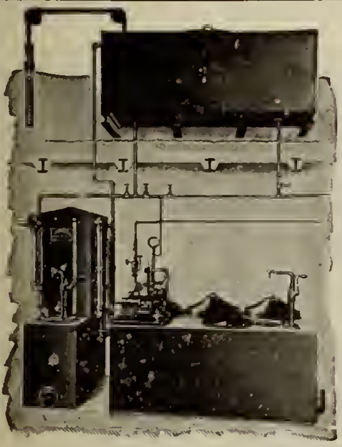

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Per J. T. Gordon.

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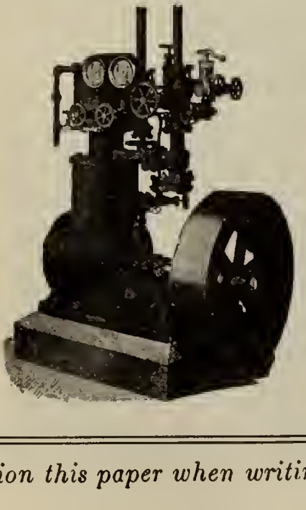

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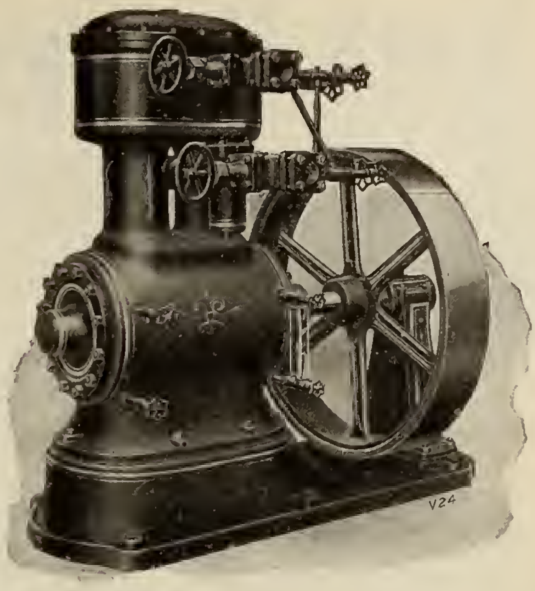

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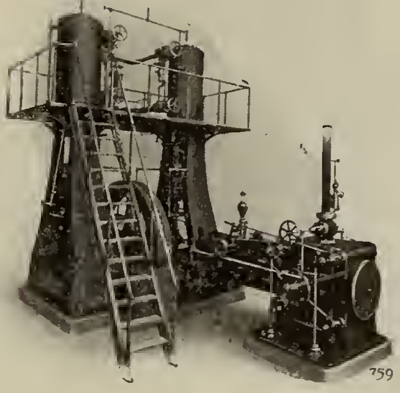

have a distinctive character all their own — in Workmanship, Durability, and Efficiency.

They embody many features not found on other Machines, and yet they are sold at a conservative price—by reason of our large output.

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Showing middle course of Nonpareil Insulating Brick in boiler setting, Pennsylvania Rubber Company, Jeannette, Pa., U.S.A. 30 000 Nonpareil Brick used in this installation.

Nonpareil Insulating Brick

For Boiler Settings

are the most efficient heat insulation yet devised for protecting boiler settings against heat losses by radiation. They are composed principally of diatomaceous earth (kieselguhr), which is one of the best nonconductors of heat, and will only transmit one-tenth as much heat as common brick or fire brick.

The convenient form of Nonpareil Brick makes them especially suitable for use in boiler settings. They are the same size as fire brick and are bonded with courses of fire brick and common brick. They are also made in standard shapes for arches, etc.

Full information and free sample on request.

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A New Improved Feature of

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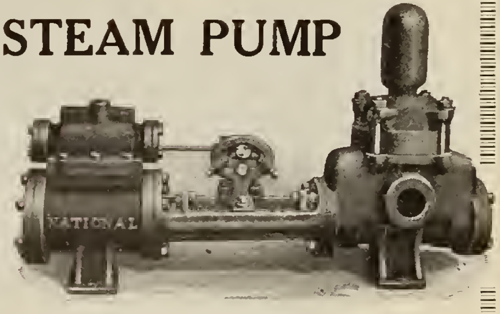
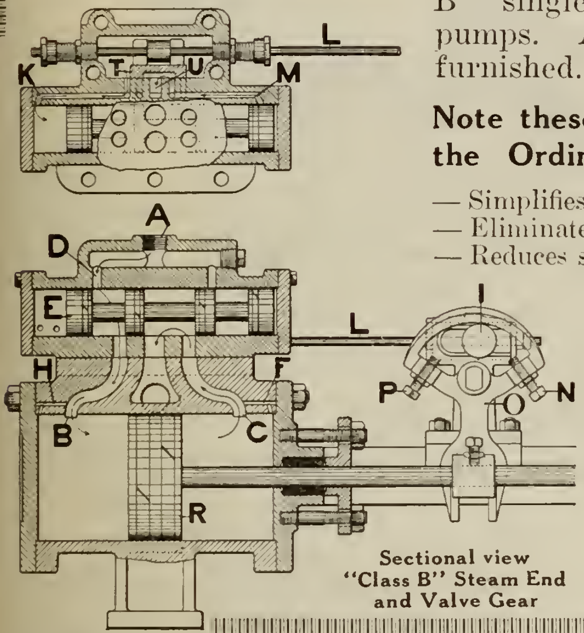
makes them unusually attractive to the discriminating pump user. This new piston valve is used on all "Class B" single cylinder National pumps. Absolute guarantee furnished.



"NATIONAL" Boiler Feed Pump



Sectional view "Class B" Steam End and Valve Gear

Note these Advantages over the Ordinary Slide Valve:

— Simplifies the steam chest construction.
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— Especially adapted for high pressures and superheated steam.
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Pumping Machinery. Steam and Power Driven

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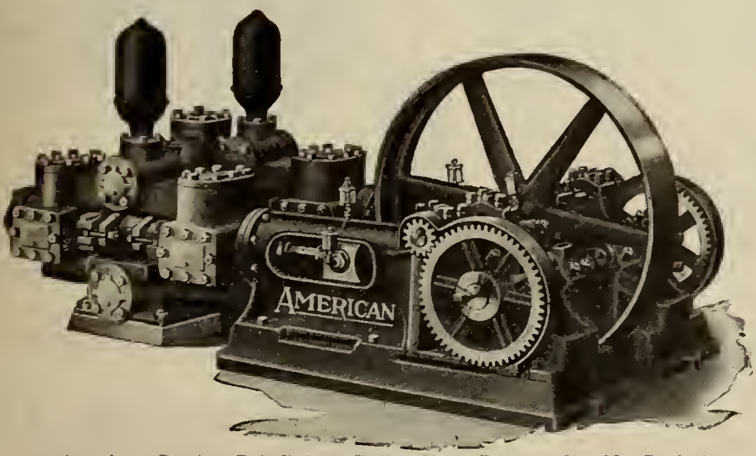

American Duplex Belt-Driven Boiler Feed Pump. Outside Packed Plunger Pattern.

AMERICAN STEAM PUMP COMPANY

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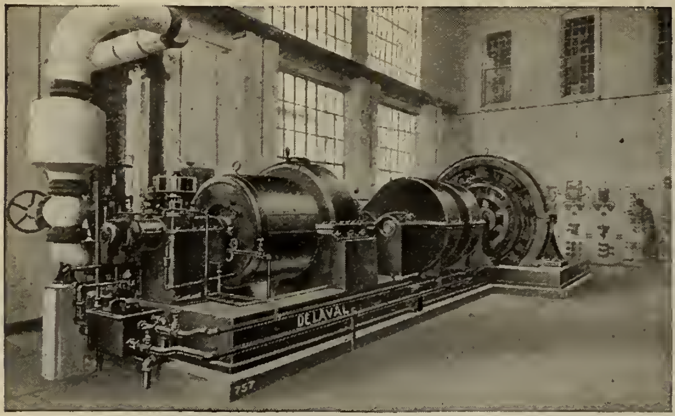

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Our experience in the construction of tried and proven designs of geared steam turbines insures a purchaser thoroughly reliable and highly efficient units.

De Laval Turbines are designed for moderate peripheral speeds and large running clearances. The casings are split horizontally and internal parts are easily accessible, although compactly built.

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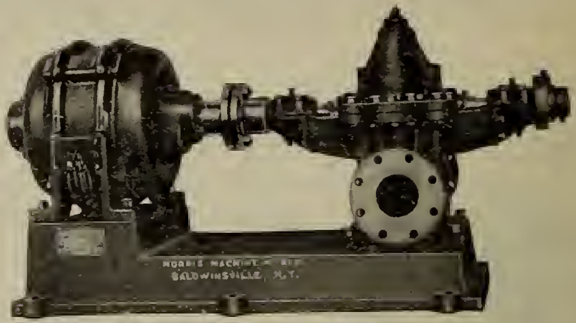
Morris Pumps



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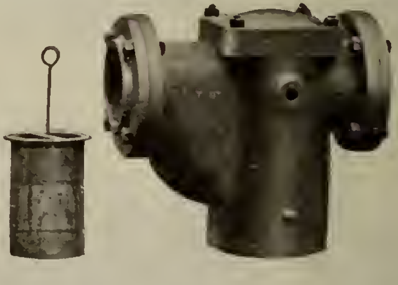

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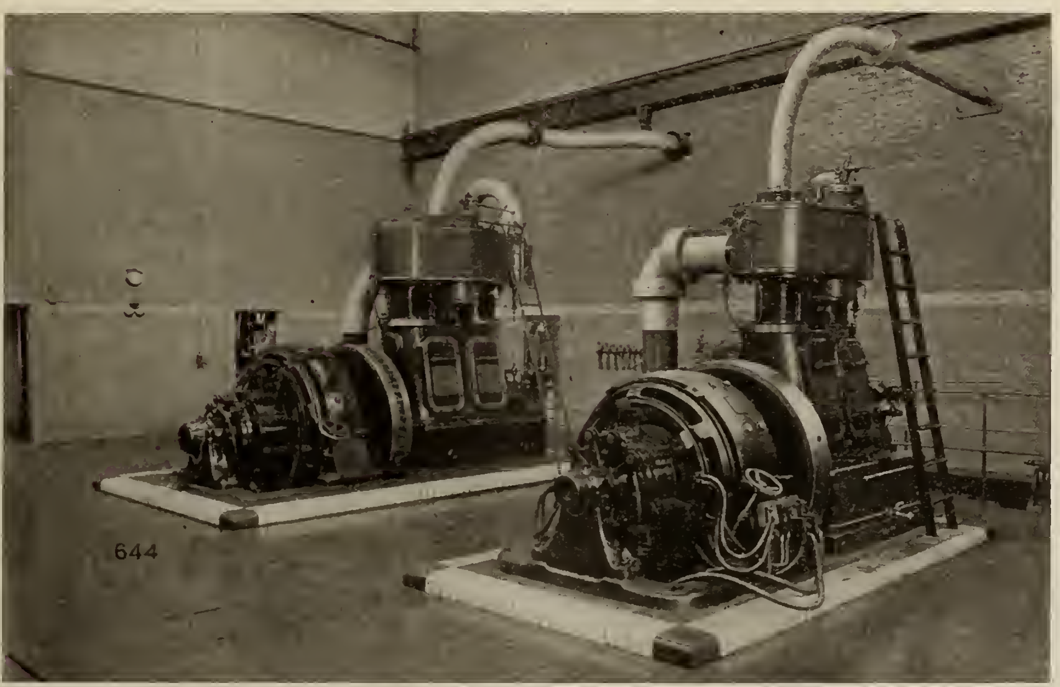

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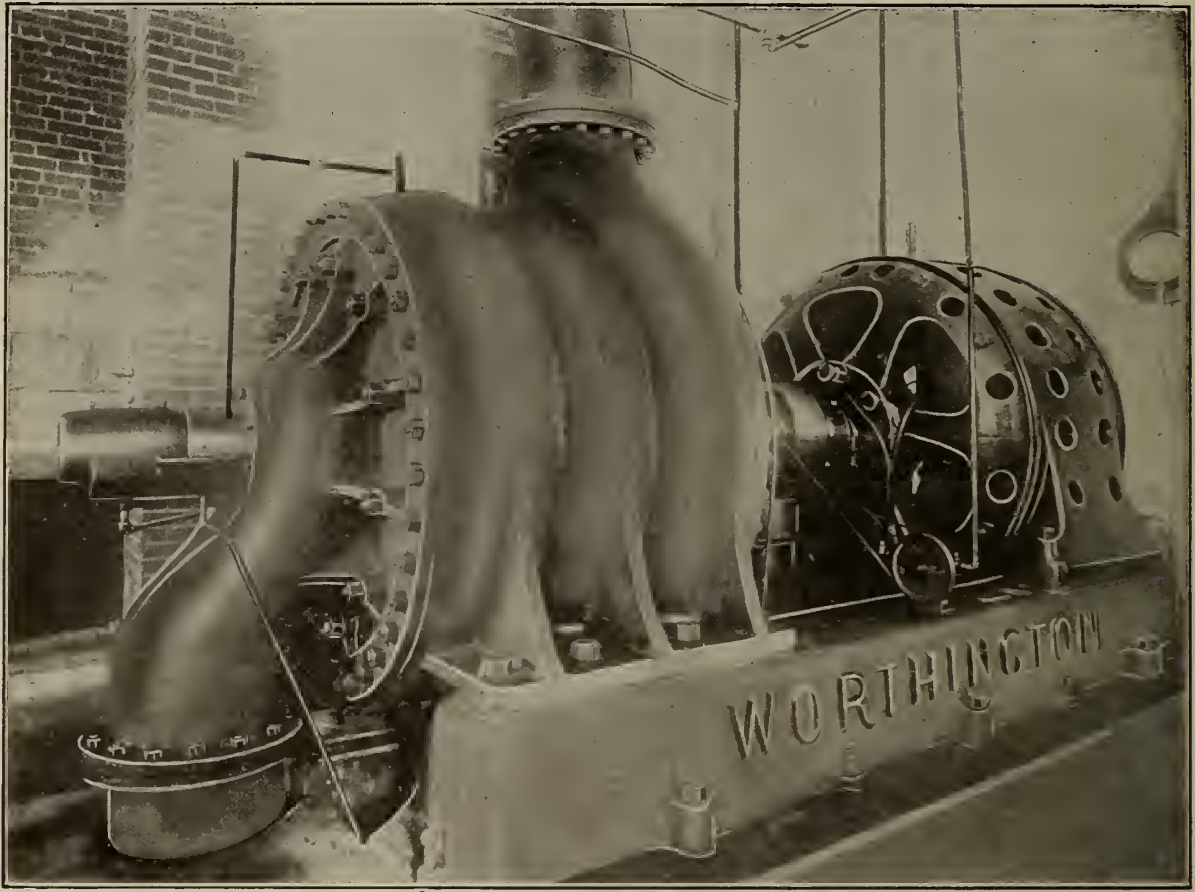

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Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment
of their Boiler, Feed and General Service Pumps

The Publisher's Page

A Letter of Appreciation

HERE is a letter from one of our good friends, Mr. A. E. Davis, Chief Engineer St. Michael's Hospital, Toronto. A most capable engineer, studious, observant, resourceful and ready for emergencies. Mr. Davis is a close reader of Power House.

The MacLean Publishing Co., Ltd.,
143-153 University Ave.

Gentlemen:

I wish to say a few words concerning The Power House magazine. **I find it a very helpful magazine** in the different courses which are published each month.

I think every Engineer should have Power House in his library. It comes in every month and **keeps him in touch with the different methods that are going on outside of the plant** which he is charge of.

I always look forward to The Power House each month, as there is always something new and interesting. Take the **operators' point of view** and the **Operators' Instruction Course, and the Question and Answer Series; those three courses in one issue are well worth the money** which the reader pays for it in a year.

One not only gets the opinion of one man, but the opinion of many. If you are not just sure of anything, put the question in The Power House and you may rest assured that it will be answered correctly for you; that alone is worth a great deal to anyone working at the engineering profession.

I certainly do think any one wishing to better himself in the engineering profession and **keep in touch with the up-to-date methods of plant operation** should have in his possession that well known and up-to-date magazine called The Power House.

A. E. DAVIS,
Chief Engineer,
St. Michael's Hospital.

We have many similar letters on file—all appreciated, all welcome and all encouraging, but it has occurred to us that many an interesting experience would come to light if our readers would write telling us of some *specific* instance were Power House has helped — where it has solved a knotty problem or brought a new idea which worked out in practice.

We should be glad to hear from our engineer friends along the above lines.

Power House has helped hundreds of engineers who have told us so, but few have been really specific as to their experiences.

THE POWER HOUSE
143-153 University Avenue, Toronto, Canada
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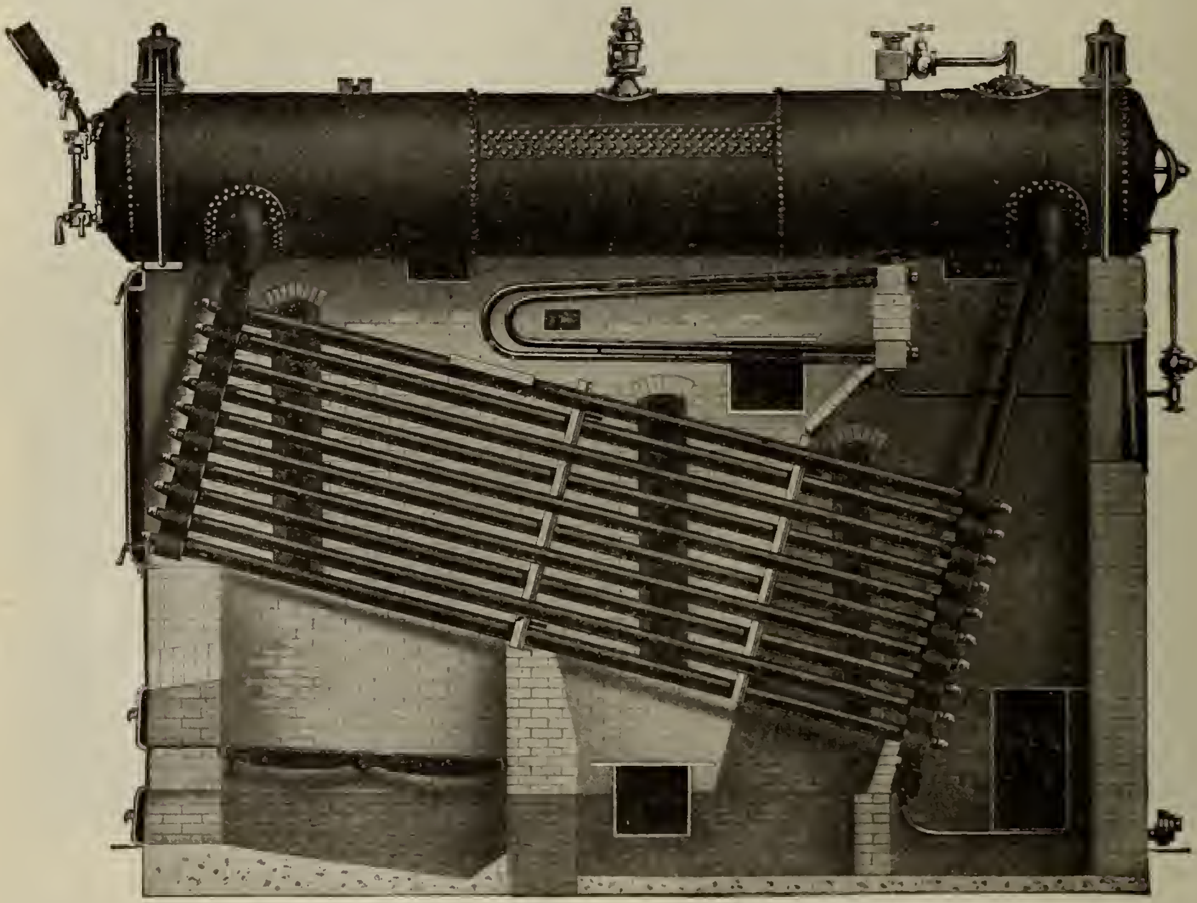
SERVICE and ECONOMY

are the Two Main Requirements in Your Power Plant

G. & McC. ENGINES and BOILERS

are designed and built by experts to give the greatest possible service on the lowest possible fuel consumption.



Sectional View Showing Construction of G. & McC. "Type B" Sectional Water Tube Boiler.

The increasing demand for the highest quality and efficiency is fully realized in these boilers. **Every part subjected to steam pressure being made of Forged Steel,** the large Steam and Water Drums and increased size of connecting nipples cause them to excel in positive and rapid circulation and in increased steaming capacity.

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Power and Manufacturing Equipment of a Shingle Mill

By A. F. Menzies

Despite the fact that our readers are more or less familiar with the appearance of and the many purposes for which shingles find a ready market, few, beyond the districts in Eastern and Western Canada where they are produced in enormous quantities, may be said to be informed as to plant and equipment requirements for their manufacture. The accompanying article sheds considerable light on these features and incidentally gives prominence to an extensive and valuable Canadian industry capable of still further development.

THE Shull shingle mill, situated on the north arm of the Fraser River in the municipality of Burnaby, is reputed to be the largest of its kind in existence. The site occupied is approximately 12 acres. The entire mill is devoted exclusively to the sawing of cedar shingles, which are shipped via the British Columbia Electric Railway, a spur track from that company's line between New Westminster and Eburne, running alongside the shipping shed. Connection is available at New Westminster for transfer to several transcontinental railways. Being on the river bank, water transportation is available for the delivery of logs and shingle bolts to the mill.

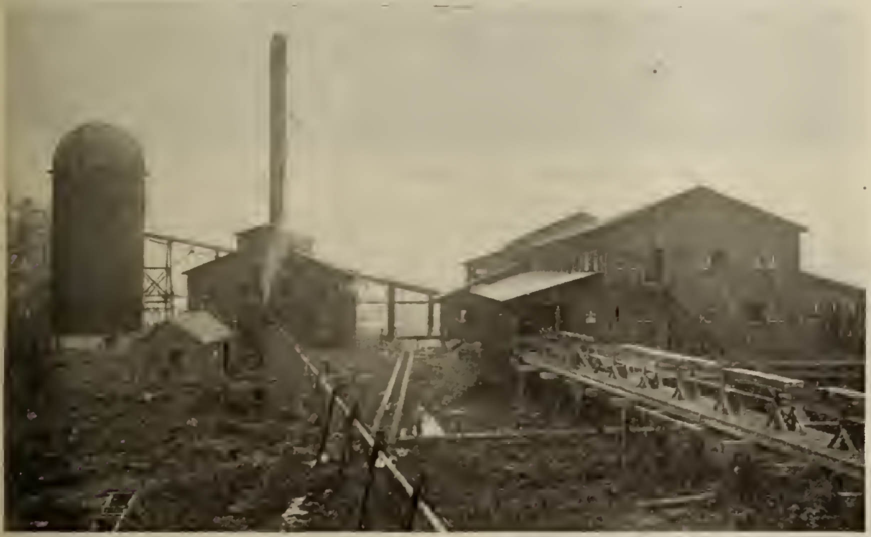

FIG. 1. GENERAL VIEW OF PLANT FROM TOP OF DRY KILNS.

The mill itself was designed by Mr. Lustig, of the Sumner Iron Works. Everett, Wash., which concern supplied a large portion of the machinery installed. Construction was carried out by the owners and was under the supervision of F. W. Talmadge. The total cost was in the neighborhood of $150,000, and the twenty shingle machines now installed are giving an output of 600,000 shingles per day of 10 hours. Space has been left on the manufacturing floor for four more machines which will bring the capacity up to 720,000 per day. Fig. 1 gives a comprehensive view of the plant as a whole, the dry kilns excepted, the photo being taken from the top of them.

A mill of this size naturally requires a power plant of considerable capacity In this case the designer should be complimented on providing a generous supply, which is not always done. All lumbering operations are attended with considerable waste of timber, sawdust being also produced in great quantities; the latter is almost always used as fuel under the boilers. Steam is supplied by four 72 in. by 18 ft. return tubular boilers, which are allowed a working pressure of 160 lbs. per sq. in. They are located in a semi-fireproof wood boiler house, situated about 39 feet from the mill building. The boilers are in brick settings with "Dutch Ovens," and the fuel is fed automatically to the fire holes by chutes from the conveyor, which brings it from the mill.

Fig. 2 is a photo of the stokehold and shows the chutes which lead to the fire holes. The platform, beyond the "Dutch Ovens," consists of steel plates carried on 6 in. I beams, spaced 30 in. centres. The smoke boxes of the boilers are connected by a breeching to the 6 ft. by 100 ft. steel stack, the top 20 feet of the latter having a spark arrester screen. The boilers. uptake and stack were constructed and supplied by the Vulcan Iron Works. New Westminster. A large bin, 12 ft. by 54 ft., is provided at the back of the stokehold for storing a supply of waste timber for use at nights and at other times when the mill is not running and no sawdust is being produced.

Boiler Feed Arrangements

Feed water from the Fraser River is stored in a 40,000-gallon settling tank, located outside the boiler house, and is drawn from the tank by a 7½—5—6-in. Worthington duplex boiler feed pump. The feed is delivered to the boilers through a Reilly multicoil feed water heater, supplied by the Canadian Griscom-Russell Co. The heater is located in the exhaust line from the main engines and delivers the water at about 220 de-

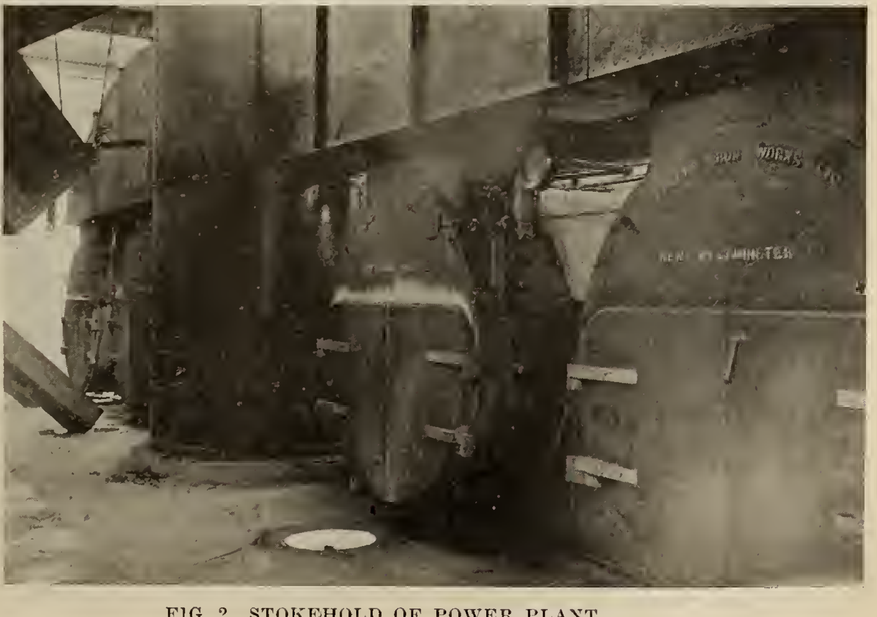

FIG. 2. STOKEHOLD OF POWER PLANT.

grees F. The feed regulating valves are provided with extension spindles, to enable them to be operated from the front of the boilers. A 2 in. Penberthy injector is provided as a stand-by for boiler feeding purposes.

Steam Piping

A 12 in. by 38 ft. steam header runs the length of the boiler room, and is connected to each boiler so that any one may be cut out without affecting the remainder. The header is constructed of extra heavy pipe and fittings, and was designed and built by the chief engineer of the plant. The main steam line, 9 inches in diameter, is taken from one end of the 12 in. header, and is provided with an extra heavy swivel expansion length, constructed by the Vancouver Engineering Works, Vancouver. Two 3½ in. steam lines are taken from the header—one to the dry kilns and the other to the underwriters' fire pump. The former line is about 350 feet long, and can be seen, supported on wooden "A" frames, in the foreground in Fig. 1. All the steam pipes are covered with asbesto-cel pipe covering, supplied and put on by the Vancouver branch of the Canadian H. W. Johns-Manville Co. Where exposed to the weather, the pipe insulation is protected by an additional waterproof cover. Crane Co. valves and fittings have been used exclusively in the pipe work, the Crane "Navy" valve being in evidence in all important places.

Engines and Generators

The mill drive is provided by two 18 in. by 20 in. twin horizontal, balanced valve engines, of Sumner Iron Works make. These prime movers turn up 190 r.p.m., and develop 440 horse-power each. They are provided with "Gardner" throttling governors, and sight-feed lubricators are fitted on all important bearings. The engines are set side by side, but facing opposite directions. Fig. 3 shows one of the engines, with part of the flywheel of the other showing on the extreme left. The engine foundations are of concrete, poured round closely spaced piling. The ground in the locality is of alluvial formation and bedrock too far down to reach, therefore, piling was the only method available, and the concrete monolith was given a very wide base to increase the bearing surface. The engines are each fitted with a double arm band wheel, 8 ft. in diameter, and of suitable width for the 30 in. driving belts.

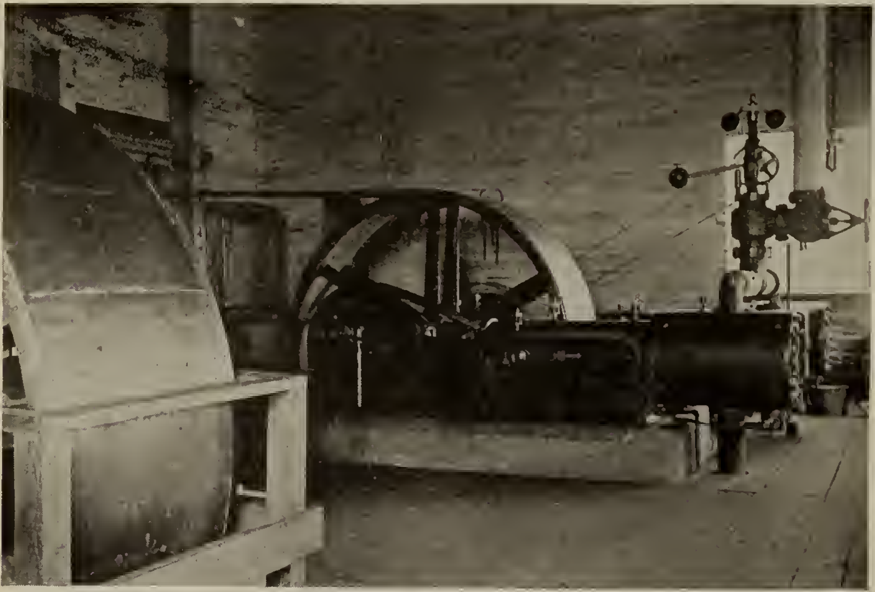

FIG. 3. ONE OF THE TWIN 18 IN. X 20 IN. MAIN DRIVING ENGINES.

A separate electric generating system is provided for lighting the plant. The generator is a 15 kw. machine, built by the Three Rivers Electric Co., Mich., and direct coupled to a twin single acting enclosed steam engine running at 500 r.p.m. The engine was supplied by the U. S. Rapid Fire Gun & Powder Co. of Derby, Conn. The generator is compounded for 110 volts at no load, and 115 volts at full load.

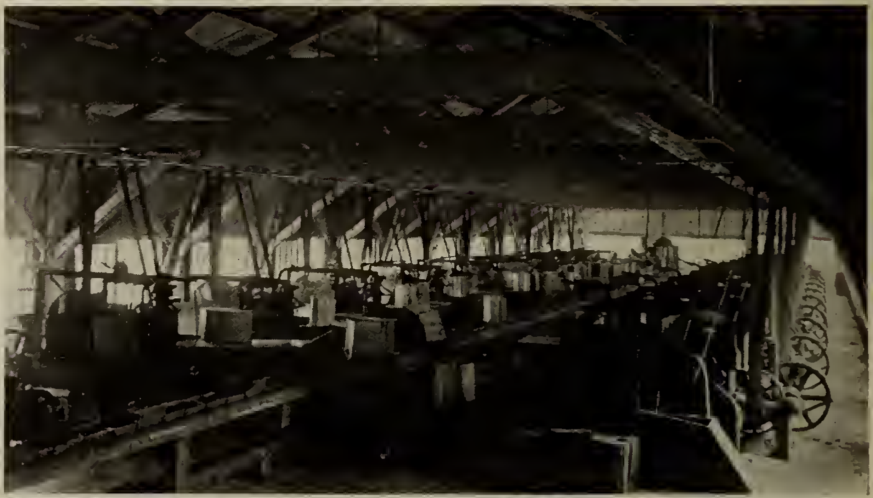

FIG. 4. SHOWING THE TWENTY SHINGLE MACHINES.

Fire Protection

Fire protection is provided for by a 16—9—12 in. duplex Underwriter fire pump, built by the Canada Foundry Co., Toronto. This pump is kept running constantly to ensure a certain supply of water at the various hydrants located at suitable places in the mill buildings and at strategic points on the mill site. The 10 in. suction pipe from the fire pump is led into the river, the lower portion being on a float, which keeps it off the river bottom, and which rises and falls with the tide. The movement of the pipe is procured by a ball and socket joint. The 8 in. discharge is placed underground, risers being provided at the hydrants. Besides fire duty, this pump is utilized to keep the settling tank supplied with feed water for the boilers, and also to supply the shingle saw water jets.

Driving Belts

The driving belts in the mill were supplied and installed by the Western Oil & Supply Co. of Vancouver. Some of the principal items under this heading are:—Two main drives, 30 in. by 2-ply "Amphibia" leather belt, one 110 feet and the other 61 feet long; 506 lineal feet of 10 in. by 5-ply balata belt on miscellaneous drives; 793 feet of 8 in. by 5-ply on drives to the shingle machines; 1,144 feet of 5 in. by 4-ply on the drives from the shingle saw arbors to the countershafts, and from the latter to the jointer saw arbors. These latter show prominently in Fig. 4. The leather belting was made by Sadler & Haworth, Montreal, and the balata by Jas. Dawson & Sons, Lincoln, England. Practically all the belting is made endless, being taken up automatically by weighted tightener pulleys.

Mill Equipment

The mill proper occupies a two-floor building, 200 feet wide by 72 feet long, the upper storey, occupied by the shingle machines being 40 feet wide. The building is of heavy timber construction, and is carried on a pile foundation. The end of the mill nearest the river has three haulways extending down into the water, two of the haulways being equipped with 9 in. by 1¼ in. chain, with flight attachments, and used for hauling up the cedar logs. The other haulway is used for shingle bolts, of which a considerable quantity are used. The log haulways lead to two 84 in. swing cut-off saws, which cut the logs into 16 in. or 18 in. lengths, depending on the size of shingles being made. After being cut off, the discs of timber are split into pieces of suitable size on two power-feed bolters. The timber is then known as "shingle blocks." To remove all sapwood and other defects, two knee bolters are used. These machines consist of a circular saw and a table on rollers, the latter having a projecting arm, which is held between the knees of the operator, hence the name. The shingle block is manipulated by hand and the table moved up to the saw by a motion of the knees.

When the blocks have been properly prepared by the knee bolter they are dumped into a conveyor, which takes them up to the machine floor. The conveyor travels the full length of the floor and the blocks are taken off and stacked on tables beside the shingle sawyers. Fig. 4 shows the machine floor, with the block conveyor running down the centre, and the ten shingle machines on each side. The shingle machines are all of Sumner Iron Works design and construction, and are equipped with their latest set equipment, which has a graining attachment to enable, if required, shingles to be taken off the block, butts up or down, instead of alternately up and down. This attachment is a great timber saver, as by its use the sawyer can keep a knot in the tip of the shingle, where it does no harm. As fast as the shingles are sawn from the block the edges are trimmed on the jointer saw and thrown down a chute to the packers.

The shingle packers are situated in the wings of the lower floor. The shingles are packed by hand into the machines, and, when a full bundle has been packed, are drawn down tight by means of a lever, which is held in a catch until the bands, consisting of two strips of wood and two strips of galvanized iron, are nailed on. The bundles are then removed and placed on conveyors, which take them to the dry kilns. The open-air portion of these conveyors can be seen in Fig. 1, where several bundles of shingles are shown en route.

Heating and Drying

The output of the mill is dried in four dry kilns, each 120 feet long by 21 feet wide. Each kiln has three tracks of light rails running clear through it. and extending beyond at each end. At the entrance end the bundles of shingles are piled on trucks in such a way as to permit a free circulation of air among them. The trucks are run into the kilns, where they remain about ten days, gradually working down to the lower end as those ahead of them are removed. The heating of the kilns is provided for by 10,000 feet of 1¼ in. pipe in each, in which steam is circulated. The steam is admitted to a header, located a short distance from the "wet" or entrance end. From the header the 1¼ in. pipes run to a similar header at the other end. Provision is made for the expansion and contraction of the piping, under a variation of temperature, and also for inequalities in length, by having, on the end of each run of pipe, an 1¼ in. by ⅜ in. elbow, the connection to the header being made by a ⅜ in. nipple threaded right and left-hand, and about 2 ft. long. The heating pipes are laid on a slight grade, and all condensation runs to the outlet header, from which it is trapped by four "Stoney" steam traps. The dry kilns were put in by the North Coast Dry Kiln Co., and the doors are of their special design. The temperature of the dry kilns is kept as nearly as possible between 185 and 195 degrees F., and is separately recorded for each kiln by a Bristol recording thermometer, having seven-day recording charts.

At the lower end of the kilns a large loading shed is provided, in which is a transfer track and car. By this latter means the loaded dry kilns trucks, on removal from the kilns, can be transferred to any loading berth desired. Two steam shingle presses, by Webb & Gifford, of New Westminster, are used in the loading shed to press the shingles in the bundles up tight. Naturally the trip through the kilns dries them out, and although the bands were tight on the bundles when packed, they are quite loose when removed from the kilns. After being pressed up, the bundles are run into waiting cars on gravity conveyors.

Shafting and Conveyors

To return to the mill building, the centre 40 feet of the lower floor contains the two main line shafts, each of which is driven by its own engine. The shafts are 5 inches in diameter where the power is received, being reduced in size as it is taken off. They extend the full length of the building. Between the shafts there are three conveyors, two for sawdust and one for spalt. These conveyors receive the sawdust and spalt through chutes from the shingle machines which are directly above on the upper floor, and discharge into two others running at right angles, one of which takes the sawdust to the stokehold and the other takes the spalt to the burner. Fig. 1 shows these conveyors running on an up-grade from the mill to their destinations. The spalt conveyor runs through the bin at the back of the stokehold and a supply of spalt is maintained in the bin by setting a tripper to throw the blocks off.

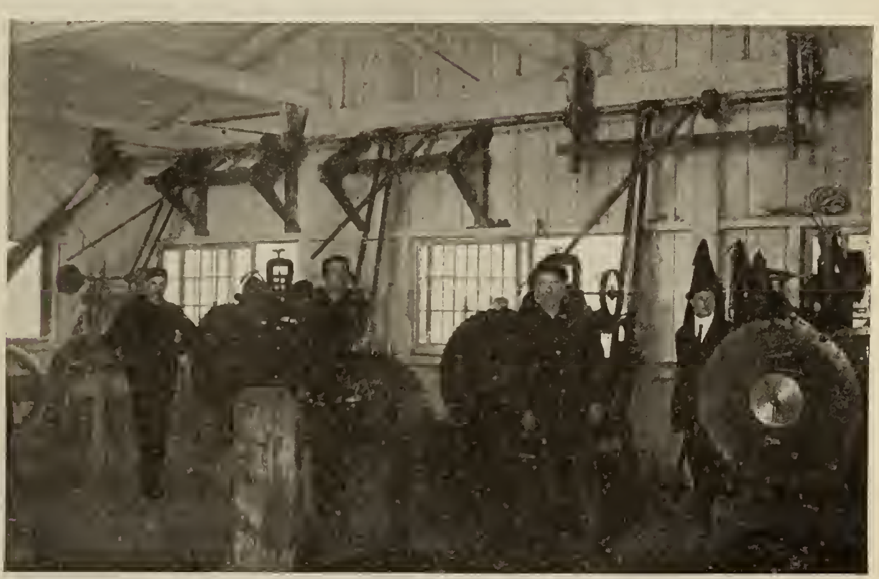

FIG. 5. SAW REPAIR AND FILING ROOM.

The burner, shown on the left in Fig. 1, is of steel with a brick lining; it is 28 feet in diameter and 80 feet high, with a spark arresting dome, 20 feet high on top. The burner is on a concrete foundation, and is kept busy all the time the mill is running, consuming the refuse.

The Saw Feature

The business end of the mill, the saws, were all supplied by the Vancouver branch of the Henry Diston & Sons Co. The outfit comprises: Sixty 40 in. shingle saws; forty 38 in. jointer saws for use on the shingle machines, there being three shingle and two jointer saws provided for each machine; four 86 in. inserted tooth cut-off saws; three 66 in. inserted tooth splitter saws; two 56 in.

inserted tooth cut-off saws, and three 52 in. knee bolter saws.

To do good work, saws must be kept in first-class shape. Their upkeep is attended to in a filing room on the same floor as the machines. A convenient system of getting the saws into the filing room is utilized. A series of pigeon holes opening into the filing room, and also into the machine room, are built into the dividing wall. A dull saw can be placed in its proper pigeon hole from the machine side, and withdrawn by the filer into the filing room when he is ready to attend to it. Similarly, a sharp saw is put in from the filing room side and withdrawn from the machine side. The filing room was equipped by the Henry Disston Co., and is supplied with two No. 55 and one No. 35 Covel automatic saw gummers. These machines are shown in Fig. 5. A large automatic saw gummer is located on the log floor and is used for sharpening the 86 in. cut-off saws, an overhead traveller being provided to bring the saws to the gummer and return them. Power for the filing room is preferably independent of the main engines. In this case a small vertical engine, manufactured by F. X. Bertrand, St. Hyacinthe, Que., and supplied by the Canadian Fairbanks Co., is installed.

The plant is operated under the supervision of Superintendent T. O'Connell; the steam end being in charge of F. G. Phillips, chief engineer, assisted by J. Anderson, second engineer.

IS THE LANCASHIRE BOILER DOOMED?

UNDOUBTEDLY the headway now being made by water-tube boilers of the Babcock & Wilcox type in Great Britain, says a contemporary there, points to such a competition within the next few years as to suggest to some engineers the ultimate extinction of the two-flue boiler. A great element in the argument is that of comparative cost, the outlook for fuel prices being also taken largely into account in adjusting the figures of relative economy. Manufacturers are bound to examine production costs more closely than they have done in order to meet the fiercer competition which is said to be impending.

The figures resulting from tests are adverse to the Lancashire boiler if taken without incidental items bearing upon the cost of maintenance and the payment of wages. It may be possible to show a margin of efficiency in favor of the water-tube boiler, but if the upkeep is greater and the working costs are heavier, the comparison is altered. Among its merits, the Lancashire boiler claims that it needs less skilful attention and less costly repairing than its rival. The question of all-round efficiency will determine the issue. Boilers of the Lancashire type, although comparatively few as regards installation in Canada, have in the past easily constituted a majority in power and manufacturing plants in Great Britain.

GAS ENGINES FOR BLAST FURNACE GAS

IN a paper by Professor Hubert, Liege University, Belgium, before the Iron and Steel Institute, it is noted that the utilization of blast furnace gas in gas engines may be considered to date from 1894, when experiments were begun by B. H. Thwaite at the Glasgow (Scotland) Iron Works, and almost contemporaneously similar experiments were independently made at Seraing, Belgium, and at Hoerde, Germany. In 1897 the Cockerill Co., at Seraing, after experimenting on an 8-h.p. engine, built the first large blast-furnace gas engine, developing 200 h.p. This engine, put into operation in April, 1898, consumed 3,329 cu. m. of gas per horsepower hour. The calorific power of the gas was 981 calories per cubic meter. From this point rapid progress was made, until at present engines of 8000 h.p. in 4-cylinder types, and of 3200 h.p. in 2-cylinder types have been built by the Cockerill Co.

The Cockerill Product

The latest type of engine built by them has had unusual precautions taken with it to avoid the accidents common to all large gas engines, such as fractures of the cylinder heads, pistons, piston rods, connecting rods, and the bending or breakage of crank-shafts. Higher average working pressures are obtained by the use of a built-up piston, bolted to a ring forged on a rod. The mass of metal presented to the gas flame is reduced, thereby avoiding the danger of pre-ignition or premature explosion. Pressures of 78 lbs. per sq. in., instead of the usual 64 lbs. can be allowed, thereby securing higher compression and insuring high thermal efficiency and a limited gas consumption.

The governing mechanism allows a speed variation of plus or minus 2 per cent. for driving dynamos, while a hand mechanism permits of this being varied, when running, from 10 to 15 per cent. The conditions of wide speed variation required by blowing engines have been met by a new system of governing which permits the mean speed of the engine to be adjusted as desired to 49, 90, 126 and 262 r.p.m. and to be further varied by governing within 50, 24, 16 and 11 per cent. respectively of the mean speeds.

Other Successful Products

Of successful gas engines of other types probably the most interesting are the high-speed vertical, multi-cylinder engines built by the British Westinghouse Co., and the National Gas Engine Co. These consist of units compounded together, each comprising two vertical single-acting four-cycle cylinders, the pistons of which are mounted on the same rod. Each unit drives a crank on the engine shaft and develops, usually, 250 h.p. Increased power is obtained by increasing the number of units. The engines run at from 200 to 250 r.p.m., which permits of their use for driving turboblowers. The weight per horsepower of these engines is only about one-half that of horizontal, double-acting, two-cylinder tendem engines.

Blast Furnace Gas Utilization

The latest development in the economic utilization of blast-furnace gas consists in passing the exhaust gases from the gas engine through a boiler and economizer, wherein steam is generated at a pressure of about 114 lbs. per square inch. The amount of heat carried off in the exhaust from the engines may be as high as 2600 B.t.u. per horsepower hour. In the arrangement adopted at the Cockerill Works, the gas enters the boiler at about 450 degs. Fah., and is reduced in the economizer to 230 degs. The gases from four gas engines aggregating 5000 b. h.p. are now employed in this manner.

About 1.93 lbs. of steam per electrical horsepower of the engine are generated by this means, developing about 650 h.p. in a steam turbine. The boilers recover about 55 per cent. of the heat of the gases and increase the thermal efficiency of the engine about 13 per cent. With an installation of four blast-furnace gas engines, developing 10,000 h.p. and costing $380,000, the cost of the recovery appliances (boilers and turbine) is put at $46,000. With interest and redemption of capital taken at 13 per cent., and with an annual outlay of $2,000 for wages and maintenance, the saving to be effected by the recovery of the heat in the exhaust will amount to approximately $19,400 per year.

* * *

Selection of Coal.—The proper selection of coal for each plant is essential to secure the maximum economy. Some plants will find screenings to be the most economical, while a plant in the same block may fine run-of-mine to be the best Still another plant might find nut, pea and screenings the best. Local conditions must be considered, and tests are the only way in which the best kind of coal can be determined. What your neighbor finds to be the best may be the worst for your plant. Price per ton has very little to do with this matter; it is purely a case of the cost of fuel per pound of steam.

The 1916 C.A.S.E. Convention and Supplies Exhibition

Staff Article

This annual double function took place in the Technical School, Montreal, during the last week in July, and as will be noted from the racy detail of the business and entertainment features which follows, a new record of profit and pleasure was again established.

THE 27th Annual Convention of the Canadian Association of Stationary Engineers was held in the Montreal Technical School, Montreal, Que., from July 24 to July 28 inclusive. In co-operation with the aims and purposes of the C.A.S.E., its Exhibitors' Association spared no effort to make the entire week one of pleasure and profit; not only to the attending delegates and their friends, but to all those who had the privilege and opportunity to be present at the Power Show, which proved to be one of the most successful yet held, The spacious and well lighted hall was ideal for the purpose and every available foot of space was taken up by well arranged and attractive booths that vied with each other in displaying their contents to interested visitors. The greater number of exhibits were in place by Monday noon and the Power Show was open to the public on the afternoon of that day.

Second Day—Tuesday

The official opening of the exhibition and the address of welcome to the C.A.S.E. delegates took place on Tuesday at 10 a.m. in the main hall. Alderman Dougald MacDonald, on behalf of Mayor Martin who was unable to be present, extended a cordial welcome to the visiting delegates and their friends, and also, to the exhibitors, who had arranged in such an attractive manner, an exhibit of power equipment and supplies, for the benefit and instruction of the engineers who in many cases have not the opportunity of studying the latest and best developments in power plant practice. He wished one and all an enjoyable and profitable time during their stay in the city. Amongst others who addressed the gathering were; president Dyson; vice-president Forbes; W. H. Johnston, president of Montreal Lodge; Louis Guyon Esq., chairman Board of Examiners, Province of Quebec; Messrs. R. Marchand and E. Valiquet of the Quebec Board; D. Medcalf, chief inspector of steam boilers, Province of Ontario; and H. L. Peiler, president of the Exhibitors' Association.

While the Grand Lodge and delegates were having their preliminary session, the visiting ladies were given a motor ride through some of the more interesting sections of the city. At 7.45 p.m., the delegates and their friends assembled in special cars for a trip around the mountain and out to Dominion Park, where a couple of hours (and some shekels) were spent, in testing out the various forms of amusements, with which the place abounds.

Third Day—Wednesday

The morning was devoted to a Grand Lodge Session of the engineers, while the supply men were kept occupied in the exhibition hall. The afternoon was set aside for the Exhibitors' Annual Picnic. Contrary to the custom of former years when the day was spent in games and other sports, along with the usual contest for supremacy in ball tossing, club swinging, base running and other forms of physical torture, the entertainment committee had planned a railroad trip by G.T.R. to St. Anne de Bellevue, an hour's sport on the campus of MacDonald college, and thence to the boat for a return trip to Montreal, way of the St. Lawrence river and through the famous Lachine Rapids. Earlier in the day it was reported that the Engineers' team had been working under "high pressure" in order to furnish "batteries" with plenty of staying power. "Ball bearing fans" of the supply men however, thought they were a lot of "hot air blowers" that would soon become exhausted. Owing however, to the brief period between the arrival of the train and the departure of the boat, it was found necessary to dispense with the ball-game, to the keen disappointment of several of the would-be contestants.

Despite the rain—which came on shortly before the arrival of the boat, and continued for some time during the trip, the excursionists were given a very pleasant journey down the river and

C.A.S.E. DELEGATES AND MEMBERS OF EXHIBITORS' ASSOCIATION IN FRONT OF MONTREAL TECHNICAL SCHOOL.

through the Rapids. Many of the visitors were much impressed as the vessel was skilfully piloted through the rocky passage of the main Rapids, and the vivid imagination of some of the onlookers was given full scope as huge rocks showed their dark and imposing forms above the surface of the water, and within a short distance of the vessel's side. Continuing the trip down the river and under the Victoria Bridge, the boat arrived at its destination about 7 o'clock, when the special cars took the picnickers to their various destinations.

Fourth Day—Thursday

During the morning the final session of the Grand Lodge took place, at which the business of the Convention was successfully concluded; the election of officers taking place and resulting as follows:—President, W. G. Forbes, Montreal; vice-president, R. G. Gofton, Berlin; treasurer, A. W. Heath, Hamilton; secretary, J. Hale, Hamilton; conductor, W. Cooke, Belleville; doorkeeper, J. Beasley, Chatham. It was decided to hold next year's convention in Toronto. At this meeting Walter Damon, president N. A. S. E., addressed the assembled delegates. He said he was pleased to note the splendid progress of the Canadian Association and more especially the Local Lodge, which, although the youngest was at the same time the largest individually.

While the Grand Lodge was in session, the Exhibitors Association held their Annual Meeting, at which several important matters in connection with past, present and future exhibits were briefly dealt with. While some of the members thought the attendance was not as good as might be desired, the consensus of opinion seemed to be that this year's Power Show had eclipsed all previous functions. A feeling of mutual goodwill and co-operation had permeated the entire proceedings. The following officers were elected for the coming year, Past President, H. L. Peiler of H. L. Peiler & Co., Montreal; president, E. F. Hetherington of Goldie & McCulloch Co., Galt; first vice-president, L. Archibald, Dart Union Co., Toronto; second vice-president, C. N. Schragg of Can. Allis-Chalmers, Toronto; treasurer, B. G. Newton of "The Power House," Toronto; secretary, G. C. Keith of the "Canadian Manufacturer," Toronto; asst. secy., L. A. Rumage of V. D. Anderson Co., Cleveland; supt. of exhibits, J. E. Fiddes of The Standard Sanitary Mfg. Co., Toronto; chairman entertainment committee, A. W. Crouch, of The Dearborn Chemical Co., Toronto; chairman reception committee, R. J. Ramshaw of The Garlock Packing Co., Hamilton. A vote of thanks was tendered to H. L. Peiler, J. A. Greig, W. R. Stavert and several others for their faithful and untiring efforts in making this year's exhibit such a complete success.

At the close of the meeting, the entire gathering adjourned to the front of the main building where a group photograph was taken; after which, a large number availed themselves of a special invitation from Mr. Beaubien to visit the plant of the Frontenac Brewery, where several "pictures" and "pitchers" were also taken, "plates" being supplied with both, although the photographer did not "film" very often.

The closing ceremonies of the Convention were held in the afternoon, when the installation of officers for the ensuing year took place. The meeting was opened and closed by singing of the National Anthem, and in addition to the installation, brief and appropriate addresses were given by the newly elected officers. A very pleasing feature concluded the meeting, that of presenting a Past President's jewel to Robert Dyson, Guelph, who had very ably fulfilled the duties of the office during the past year.

In the evening a concert was given by the Montreal Lodge of the C.A.S.E., at which the following participated; Jack Armour, J. E. Fiddes, C. Stevens, and L. Lister. On behalf of the Exhibitors' Association, Jack Armour officiated in the presentation of an umbrella to W. G. Forbes.

Fifth Day—Friday

Friday was largely devoted to the Power Show. Great interest was shown by the many visitors in the magnificent display of all lines of power plant equipment. Interesting and serviceable souvenirs were given out by many of the Exhibitors.

Exhibitors and Exhibits

Ross & Greig—Packing supplies; A. Ross. J. A. Greig, Representatives.

Goldie & McCulloch—Boilers, engines and power plant equipment; E. F. Hetherington, Jas. Baker, Representatives.

Canuck Supply Co.—"Anchor" packing; Wallace Robb, E. L. Foley, Representatives.

Geo. W. Cole—Automatic boiler feeders, oil separators, etc.; Mr. Cole, Representative.

Gutta Percha & Rubber Co.—Packing, rubber belting, hose, etc.; H. B. O'Neil, Representative.

Canadian Fairbanks-Morse Co.—Gas engines, scales and engineering specialties; M. V. Cordell, E. A. Peterson, E. Rheame, Representatives.

Canadian Asbestos Co.—Asbestos supplies; P. H. Jamieson, F. J. Johnson, Representatives.

Peerless Rubber Mfg. Co.—"Rainbow" and "Eclipse" packings, etc.; E. E. Jones, Representative.

Jos. Dixon Crucible Co.—Graphite boiler compound, belt dressing, etc.; M. Brooks, Representative.

Canadian Powers Regulator Co.—Heating and ventilating supplies; A. J. Bowling, Mr. Mackenzie, Representatives.

Dunlop Tire & Rubber Co.—Hose, belting and packing; J. K. Schofield, F. R. Lafleche, Representatives.

Morrison & Dagnall—Asbestos pipe and boiler covering; J. W. Dagnall, J. Kearns, Representatives.

Armstrong Cork & Insulation Co.—"Nonpareil" corkboard insulation; S. Purton, H. V. Cooper, Representatives.

Garlock Packing Co.—Engine and pump packing; H. J. Ramshaw, A. E. Patton, Representatives.

Canadian Allis-Chalmers Co.—Electrical appliances, pumps, etc.; C. N. Schragg, Representative.

Canadian H. W. Johns-Manville Co.—F. G. McDermont, W. F. Kirkham, Representatives.

Goodyear Tire & Rubber Co.—Rubber hose, packing, etc.; C J. Jermyn, F. C. McConnell, Representatives.

Electric Equipment Co.—Electrical supplies; G. H. Battle, Geo. Walker, Representatives.

Canadian Consolidated Rubber Co.—Mechanical rubber goods.

The Lunkenheimer Co.—Valves and high-grade engineering specialties; E. A. Wilkinson, Representative.

Lyttle, Smith & Co. (American Metal Hose Co., Bower Rubber Works, Cling-Surface Co.) —Engineers' supplies; A. F. Lyttle, E. A. Anderson, W. L. Rogers, J. D. Bresnihan, Representatives.

Economy Fuse & Mfg. Co.—Economy fuses; F. N. Adams, J. S. Painter, Representatives.

Darling Bros.—Engineering specialties; J. D. Alder, C. V. Clarke, J. H. Wiseman, Representatives.

Saddler & Haworth—Leather belting and mill supplies; W. A. Johnston, S. S. Woodward, Representatives.

Lyman Tube & Supply Co.—Electric railroad supplies, chain hoists, etc.; J. A. Fitzgerald, Representatives.

Dearborn Chemical Co.—Treatment of boiler feed water; A. W. Crouch, Representative.

Jenkins Bros.—Valves; W. R. Stavert, J. S. Mock, W. F. Trimball.

Canadian Griscom-Russell Co.—"Stratton" steam separators and "Reilly" heaters; J. K. Barrett, Representatives.

J. W. Gates—Furnaces; J. W. Gates, Malcolm Hart, Representatives.

H. L. Peiler & Co.—Engineering specialties, including "Coppus" blowers, "Mason" and "Ashton" steam specialties, Bundy traps; H. L. Peiler, E. Hatton, J. L. Galvin, F. A. Morrison, John Sabin (Nashua Machine Co.), Representatives.

Canadian Vincent Valve Co. — Automatic drain valves; J. L. Flanders, Representative.

"Canadian Manufacturer" — G. C. Keith, Representative.

Dart Union Co.—"Dart" unions; L. M. Archibald, Representative.

C. B. Turner—Plastic boiler lining; C. B. Turner, Representative.

T. McAvity & Sons—C. P. Archibald, Representative.

"Power"—Jack Armour, F. R. Low, Representatives.

"Power House"—B. G. Newton, B. L. Thompson, J. H. Rodgers, Representatives.

Standard Sanitary Mfg. Co.—Steamfitters' supplies, and Crane Co. steam specialties; J. E. Fiddes, Representative.

Dominion Belting Co.—"Maple Leaf" brand stitched cotton duck belting; John Scott, Representative.

Erie Pump & Equipment Co.

Jas. Morrison Brass Co.—Water, steam and recording gauges, stationary and locomotive injectors, valves, etc.; A. Betton, Representative.

The Exhibits for the most part were of a high order, and reflected great credit on the firms represented.

Convention By-Products

In keeping with the spirit of the times, the hall was dressed in "uniform" colors.

Delegates and visitors were given a very warm reception on their arrival at the hall. (About 95 degrees F.)

A number of the engineers and exhibitors were nearly "on the rock" Wednesday afternoon—not Thursday.

Upon arrival at St. Annes, a large number travelled a couple of miles for a drink of lemonade, "Budweiser" ones awaited the arrival of the "schooner" at a nearby inn.

The following were among the rules issued by A. L. Jones for the guidance of engineers on their visit to the Frontenac Brewery.

Filling Up.—Allow the “boiler” to become cool before pumping in “cold water”; the practice of filling a “hot boiler” with “cold water” causes leaks and fractures, and sometimes explosions. (No water was used)

Pressure Gauge.—The pressure gauge should stand at O when the steam pressure is off, and it should indicate the blowing off pressure (2 gallons), when the safety valve is in action. If the gauge does not do this, it should be compared with a standard gauge, and, if wrong, corrected. (Someone lost the standard gauge.)

Firing.—Keep the “fire” of uniform thickness, and allow no “air-holes” in the “bed of fuel.” “Fire evenly and regularly,” and not too much at a time. Keep the “fire” free from ashes and clinkers.

GENERAL VIEW IN EXHIBITION HALL.

Low Water.—Avoid low “water” in the “boilers”. Always keep a “well filled glass”. In a battery of boilers” each separate “boiler” should be tried. (Some may take longer to fill than others.)

Foaming and Priming.—In case of “foaming”, close the throttle valve of the engine, or the “stop valve” of the “supply pipe”, and keep it closed long enough to show the true “water level”. The “foaming” can generally be stopped by “blowing off” and feeding fresh “water”.

Leaks.—When leaks are discovered they should be repaired at once.

Blowing Off.—When “blowing off”, the steam pressure should be not over 20 pounds. The “boiler” should be emptied at least once every two weeks and filled up afresh. Once a week (or oftener) would be better. A “surface blow-out” should be opened for a short time at quite “frequent intervals.”

Gauge Glasses.—These should be kept clean and in “constant use”. No obstruction should be allowed to gather in the “passages” between the “gauge glasses” and the “boiler”.

Feed Pump and Injector.—Both “pump” and “injector” should be of ample size, and whichever is used should be made to work as uniformly and continuously as possible. It is best to have two independent means of filling the “boiler”.

Exterior of Boiler.—Care should be taken that no “water” comes in contact with the exterior of the “boiler” either from leaky joints or other sources. Dampness leads to external corrosion.

Unused Boilers, may be kept in good condition by filling them with “water” in which a quantity of common washing (or ice cream) soda has been placed. Another method is to empty the boiler, dry it thoroughly, place trays of quicklime in the bottom and seal it as nearly air-tight as possible. The latter method is often used for marine boilers. Very little use was made of this rule, as the “boilers” wouldn't even feed water”.

Convention Superheat

L. M. Archibald of the Dart Union Co., is about to join the Aviation Corps. He always was well to the front.

* * *

When it comes to catering to the ladies, few surpass in thoughtfulness our genial friend C. B. Turner. He was on hand with a bouquet for every lady on Thursday evening.

* * *

Earl Hetherington, of Goldie & McCulloch Co., Galt, newly elected President of the Exhibitors' Association has shown that he can “come back”.

Dad Wickens “Father” of the C.A.S.E. was on hand as usual.

* * *

“Brother” Jones was heartily congratulated upon his success in developing and publishing the very creditable Convention Souvenir.

* * *

H. L. Peiler, retiring President of the Exhibitors' Association and his committee deserve much praise for the energetic way in which they staged this year's Exhibition. It is now up to Toronto to equal what Montreal has done and perhaps go one better.

* * *

D. M. Medcalfe, chief of the Boiler Inspection Dept., Ontario Government was present with all manner of blue prints, samples, charts, etc., not to mention his most official smile which positively refused to come off, despite the heat.

* * *

H. L. Peiler, John A. Greig and W. R. Stavert established reputations as hard workers.

* * *

Jack Armour was in fine fettle and proved just as entertaining as ever.

* * *

G. C. K.'s waist measure, if anything, has increased, and with it apparently his capacity for convention work.

* * *

H. J. Ramshaw, Garlock's manager (Mr. Bell now in Khaki) was one of the new faces among the Exhibitors.

* * *

W. R. Stavert (Jenkins Bros.) proved himself well qualified to fill the exacting position of Chairman of the Entertainment Committee; his idea of a trip across Lake St. Louis and down the Rapids being ample evidence.

* * *

A miniature edition of The Power House with convention humor and news was well received.

* * *

WORK OF STEAM BOILER BRANCH PROVINCE OF ONTARIO*

By D. M. Medcalf.**

I FEEL it an honor to be called upon to address you on this occasion of the twenty-seventh annual convention of the Canadian Association of Stationary Engineers, and its affiliated Supplies Exhibit. At the outset I wish to express to you the pleasure this affords me. I thought perhaps a few remarks on our method of conducting the Steam Boiler Branch, also a general resume of the work executed since the inauguration of the Steam Boilers Act and Regulations might prove of a little interest to you. The authority of the Act of the Legislature in our province controlling the construction of steam boilers establishes the following procedure:—

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*From an address delivered at the recent convention of the Canadian Association of Stationary Engineers.

**Chief Inspector, Steam Boiler Branch, Province of Ontario.

Submittal of Designs and Specifications

The manufacturer before commencing to build a boiler is required to submit prints and specifications in triplicate, giving full dimensions and particulars of material of which the boiler is made. The design is then surveyed and the strength of every part of the boiler estimated. The calculations are made in accordance with the formulae contained in our rules, and a copy of our surveyor's figures is filed with the prints, and many be referred to at any future time. If the design does not meet with our approval or is not strong enough for the pressure for which it was intended by the manufacturer, one copy is returned to them for correction, together with a letter pointing out the defects and the necessary changes to be made. Provided the drawings are satisfactory in every respect one print and specification is marked with our approval stamp which bears our record number for the design, maximum working pressure, the date of survey, etc., and is returned to the owner from which certified document an unlimited number of boilers may be constructed. The two remaining specifications and blue prints are filed in our office, one set being placed in a fire-proof vault.

Construction and Inspection of Boilers

In regard to the construction of boilers, on our specifications which accompany the prints submitted for approval, there is a notice to the effect that manufacturers must notify us at the following stages of the work:—

When the plates are on hand, and before they are bent.

When the plates are assembled and before riveting is begun.

When the boiler is completed and ready for being tested.

You will see that three is the least number of inspections we make of a boiler constructed under our supervision, although sometimes we make four or five, depending upon the amount of work we have on hand. The plates are first examined for defects, then measured by the micrometer and the melt numbers and tensile strength, also the name of the manufacturer of the plates recorded. Those particulars are embodied in our shop inspection report, of which I will make mention later.

The second inspection consists of an examination of the workmanship, to see that it is well done and in strict accordance with our rules, also with the approved design. If everything is found in order for the first two inspections, final examination is made when the boiler has without being penalized in pressure. It been completed and the hydrostatic test applied at one and one-half timees the working pressure. On completion of this test our inspector stamps the boiler as follows:—Name of manufacturer; Ontario record number; name of plate manufacturer and tensile strength; test pressure and working pressure; date of final inspection; inspector's initials.

Shop Report and Affidavit of Shop Foreman

Our inspector next fills out a shop report form giving a full account of the inspection, and the shop foreman is required to fill out our affidavit form which must be duly attested before a notary public. These forms after being checked up and compared with the approval design are given a number, which coincides with that given to our official certificate covering the boiler. The certificate in question is made out in duplicate, and mailed to the manufacturer of the boiler, one copy being retained in his files and the other being sent to the purchaser. No new steam boiler should be put into operation without this certificate. For the inspection of the boiler and issuance of certificate we charge a fee of $5. The certificate contains the following information:—Number, date of inspection, type of boiler, manufacturer, purchaser, test pressure and working pressure, together with overall dimensions, thickness of material, sizes of stays, etc.

Boilers Built Outside Ontario Province

Boilers manufactured outside of the province must be inspected at the place of manufacture by a duly authorized inspector of the government of Great Britain, or of one of the Provinces of Canada, or of the United States of America, who must fill out and mail to our office the shop inspection report sheet—which our own inspectors fill out when inspecting boilers in Ontario; the affidavit supplied by our department must also be filled out in the same manner as required in Ontario. These reports after coming to hand are thoroughly examined, and if found to comply with the approved design the certificates are issued to the manufacturer. For this work we charge $5, which is the amount chargeable to Ontario manufacturers when we make the inspection ourselves. This I might say keeps everything on the same basis. The American boilers are figured on the same factor of safety as our own boilers.

Fittings and Pipe Lines

Boiler fittings, and pipe lines are dealt with in a similar manner to boilers, with the exception that we do not make an inspection of work under construction and issue no certificates.

Departmental Record

From July 1, 1913, to July 1, 1916, we surveyed and registered as follows:—

650 boiler designs for high pressure services.

100 heating boiler designs for 15 lb. pressure limit.

797 boiler fittings designs.

11 digester designs.

1,075 boilers inspected during construction.

1,064 used boilers inspected.

42 boilers condemned.

116 pipe lines approved and inspected.

From the above you will see that we have not been idle for the past three years.

Inspection for British Columbia

I might mention that in September, 1915, at the request of the British Columbia Government, I interviewed the officials in the western provinces with a view to bringing about inter-provincial inspections. The results of my efforts in this direction were very satisfactory as far as British Columbia is concerned, and we are now making inspections of all boilers built in Ontario for British Columbia. The manufacturers of these boilers pay to the department a fee of $10 for each and every boiler inspected, together with our inspector's traveling expenses to and from the place of manufacture. Previously, British Columbia boilers were otherwise examined. We are going into this work with our usual thoroughness, and the boilers constructed under our supervision have been entirely satisfactory to the British Columbia authorities.

Inter-Provincial Inspection and Uniform Regulations

As yet we have not been able to arrange for the inspection of boilers for the other provinces, but I have every reason to believe that this will eventually come. I may say that we in Ontario are quite prepared to do everything in our power in the matter of inter-provincial inspection, as it would undoubtedly be a great advantage to both the users and to the manufacturers of the Dominion if this could be arranged. The sooner conditions are such that it can be generally adopted by the various provinces it will be better for us all. The same applies to a uniform boiler law.

I have no doubt that you are aware of the fact that in the year 1914, in the month of June, a conference was held in Toronto with representatives from British Columbia, Saskatchewan, Nova Scotia, and Quebec; Mr. Jobin representing the latter. The object of this meeting was to compile a uniform set of regulations for the various provinces, as the existing laws governing the construction of boilers in Canada are very dissimilar at present, and consequently a boiler in one province built from an approved design according to the requirements of that particular province, will not be accepted by another province is obvious that a condition of affairs such as this is very embarrassing to manufacturers and steam users, and is of little benefit to any person. A proposed new set of rules were drawn up, and at this time we are still discussing various matters by correspondence, which could not be decided upon at that time. I have every reason to believe that we will ultimately arrive at uniformity in this respect, although it is a very difficult matter to arrive at a satisfactory code of rules to suit all concerned. Some of the provinces are very conservative, one having refused to send a representative to confer at our meeting. It is a great pity that we should be unable to arrive at unanimity but I can assure you that we are doing everything in our power to get together, and I have no doubt that the Province of Quebec will see eye to eye with us in this matter.

I do not wish, however, to try and make you feel that we in Ontario are perfect. Our Steamer Boilers Act and regulations are working out very nicely for the manufacturer and user, however, and when you are drafting your regulations and are desirous of information or assistance, same will be ungrudgingly given.

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HANDICAP OF BAD BELTING

HOW many machinery users possess even an elementary knowledge of belting? Comparatively few, says a writer in Page's Weekly, yet belting in many cases serves as the great muscle of the workshop for extended power, and if the leather is wrongly fitted, as it often is, and badly-made as some specimens undoubtedly are, the belting capacity cannot be equal to specifications. Many a workshop is losing power and cash daily through its belting.

Leather Belting Characteristics

Putting aside woven belting, which has characteristics of its own, let us see how leather operates. The tenacity of good new belt leather varies from 3,000 lb. to 5,000 lb. per square inch of sectional area, and thickness averages ¼ in. Clearly, if the tenacity "varies," a danger point exists somewhere when two leathers of different tonnages are joined in one belt, although that danger may be well beyond the usual stress limit. Those two leathers may have inherent differences, as well as the differences imparted by separate tonnages and separate modes of finish, so that to specify one stress limit in pounds for two different leathers may prove misleading. The maker of the machinery concerns himself with power, speed and pulley dimensions, and the user is concerned very materially in the strength per inch of width, and if tensile strength in pounds per inch of width were added, it is argued that the user would have a better safeguard.

Our view is that while a percentage of difference exists between one piece of leather and another, the user may rest satisfied that if he purchases from a reputable maker, in accordance with clear and practical specifications, he may count on obtaining a sound article at a fair price. "Cheap" belting should be classed with other "cheap" goods. Assuming that the right belt is purchased, the fitting should receive the greatest care. Any leather will stretch after a period of use, and if the stretching is excessive then troubles ensue. The removal of undue streching is as important in its way as the original purchase, for erroneous removal has a sequel in hampered work. A thick belt stretches more on the outside than a thinner one because such a belt cannot lie so closely around the pulley. The greater thickness of material requires greater bending force, and greater friction is set up.

Belt Thickness

Uniform thickness throughout is desirable in all cases, and its influence is particularly emphasised with regard to light high-speed machinery. The cumulative importance of this is illustrated by comparing the velocity of belts on ordinary shop line shafts (1,000 to 1,500 ft. per minute) with the speed of lathe belts, which ranges from 1,500 to 3,000 ft. per minute. The item of centrifugal force has no material bearing upon the line shafts at ordinary velocities, but when the speed reaches 3,000 ft., or more, the centrifugal force tends to reduce the amount of power which a belt is capable of transmitting. Recently, we have heard of belt speeds above 5,000 ft. per minute, due to pressure of work, but such speeds should be discouraged.

Camel-hair belting constitutes a subject which should be dealt with in a separate article. Woven belting exhibits great strength and flexibility, regardless of temperature, water, steam, chemical fumes, etc., yet it is never likely to displace leather in the estimation of a host of engineers. Link belts are useless at high velocities, although they are superior to leatber belts at low speeds. In a number of instances compound belts formed by placing one belt upon another have been found to add most substantially to the power transmitted.

Some really useful substitutes for leather belts are on the market, and cotton may have a greater future on the pulley than it enjoys at present. Considering that the fibre is tested to 1,500 lb. per square inch, a belt of such material is capable of great service in the workshops.

TRANSMISSION SAFETY—III.

NUMEROUS accidents occur to men whose duty it is to oil the bearings of overhead shafting. It is highly desirable to prohibit the oiling of shafting while it is in motion, but this is not always practicable, when the bearings are of the usual type. A special form of bearing, known as a "ring bearing", is favored by many shops, and it is to be commended to the attention of those who have not tried it, inasmuch as it greatly lessens the likelihood of accidents from oiling. This form automatically supplies oil to the bearings from a small reservoir which holds a sufficient amount to last for more than a week. The reservoirs throughout the shop can then be filled on Sunday, while the machinery is idle, and in this way the danger from oiling moving shafting is entirely obviated.

When the bearings are of the ordinary type, they can be oiled with a fair degree of safety by doing the work from elevated platforms or walks, properly railed and running parallel with the shafting for its entire length. Provision can often be made for platforms of this kind when designing and laying out a shop, but it is usually a difficult matter to instal them in a shop that was erected without reference to them. Another method that can sometimes be used with advantage consists in erecting, parallel to the shafting, an overhead rail or track, along which an iron ladder travels by means of wheels or rollers. In most cases this plan is difficult of application in shops that are already in use, because the ladder would interfere with belts or pulleys, or with machinery on the floor.

Vertical pipes are sometimes extended through the floor over the shafting and immediately above the bearings, through which oil may be poured; but when this is done it is not easy to see how much oil reaches the bearing, and the attendant is therefore likely to use either too little oil, or else an excess of it. In the former case the bearing may run dry, while in the latter case a considerable quantity of the oil may be wasted. Special oil-cans are sometimes used, having necks or spouts bent in the form of a U at one end,—the necks being long enough to permit the oiler to lubricate the bearing while standing upon the floor.

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Every Governor-General since Dufferin has opened the Canadian National Exhibition.

Previous to 1885 ales and beers were sold on the Canadian National Exhibition grounds. The sale was abolished at an annual loss in booth rentals of $2,000, quite a sum in the early days of the big Fair to pay for a principle.

Electricity and Hydraulics

TURBINES FOR GENERATION OF CONTINUOUS CURRENT

IN large undertakings using continuous current, power is usually generated by turbo-generators, and transmitted at high pressure to sub-stations, where it is converted to continuous current either by rotary converters or motor-generators, but where the undertaking is small, and the distance over which the power is to be transmitted is not great, this method is not economically practicable.

Continuous current turbo-generators of various outputs up to about 2,000 kw. have been designed and are running successfully, but these machines are not altogether satisfactory from the point of view of the designer and electrical manufacturer. The high efficiency of the steam turbine, however, cannot be overlooked, and, in large units, the turbine must be utilized if low-power costs are to be attained. In a continuous current turbo-generator the designers of both ends have to compromise in order to make a satisfactory machine. The steam turbine designer has to reduce the speed of the turbine at the expense of efficiency, while the generator designer runs his machine at a higher speed than is desirable for satisfactory commutator construction.

In the ideal solution, however, the turbine should run at the high speed necessary to secure the best efficiency, while the commutator should be worked at a sufficiently low peripheral speed to prevent commutator troubles. Recently two solutions of the problem have been resorted to:—(a) The installation of slow speed generators driven by turbine through gearing; (b) the installation of turbo-alternators driving rotary converters coupled direct electrically.

Turbo-Alternators Driving Rotary Converters

An example of the second solution is afforded at the works of Fraser & Chalmers, of Erith, England, where an installation was laid down at very short notice. In this installation the proposals of the General Electric Co., comprising turbo-alternators and rotary converters, were accepted as being both reliable and economical. The installation consists of a 1,500 kw. generating unit composed of a Fraser & Chalmers turbine, running at 3,000 r.p.m., and driving a ''Witton'' 6-phase turbo-alternator, generating three-phase power at 325-370 volts, 50 cycles. This unit is coupled electrically to two 750 kw. ''Witton'' rotary converters, running at a speed of 500 r.p.m., and generating continuous current at 440 volts.

The two rotary converters operate in parallel from one winding of the turbo-alternator, and, as is well known, unless precautions be taken, trouble is met through the two rotary converters being connected in parallel on both the alternating current and the continuous current sides. In the early days of rotary converter operation it was found impracticable to run two rotary converters off the same transformer, due to the fact that there exists between each phase busbar and the continuous current busbars a number of parallel paths of low resistance. The result is that bad parallel running ensues. Where transformers are used they may be provided with two or more separate windings, each winding supplying one rotary converter. The same solution may be adopted in the case of generators, but it is not always desired to split up the generator winding into two or more parts. The two windings have been eliminated in a method introduced by the General Electric Co., the operation principle being as follows:

Operation Principle

Differentially wound balancing transformers are installed in the low pressure alternating current leads of the rotary converter. These balancing transformers are inserted in each of three of the leads from the converter. They consist of two oppositely-wound windings on the same cores. The alternating current supplying one phase of one converter is passed through one coil of the transformer, while that of the same phase for the other converter is passed through the second coil. Consequently, when the currents are equal, their effects cancel out, but should one converter attempt to take more than its share of the load, the excess current magnetizes the core and induces an electro-motive force in the other winding, which assists the current flowing therein, and tends to cause it to increase until the two currents flowing are again equal. In this way the loads taken by the rotary converters are equalized, and the unbalancing of current brought about by the circumstances related is entirely obviated.

Any number of rotary converters can be coupled to the generator and run in parallel on this principle, and, if necessary, it is possible to take part of the generator output in the form of alternating current for transforming up and distribution at a suitable pressure to outlying districts. In the installation here referred to, the rotary converters are started with the turbo-alternator and run up to speed with the machine. No synchronizing is, therefore, required. The arrangement is claimed to offer a completely satisfactory solution to the problem of generating continuous current at a lower cost by means of turbines.

FUTURE OF HYDRAULIC POWER

A REMARKABLE sequel to fuel shortage is being witnessed throughout the world. The press records the attention which, almost suddenly, is concentrated upon the utilization of water power and the prospective development of energy in that direction is used at times as a consolation for the long- prophesised diminution of British coal resources. It seems quite reasonable to assume that we are nearer the beginning than the end of our knowledge of utilising the world's three great prime movers—water, steam and internal combustion—and it seems certain that water power energy will in the future have a great bearing upon the question of fuel consumption.

All the civilised nations, also Germany, are devoting more and more attention to hydraulic power, and Italy in particular—spurred by the present enormous cost of coal—finds something worth attention in the calculation that there is enough water power in the peninsula to answer all industrial requirements. One feels certain that Britain's Dominions across the sea will continue to harness even more fully the magnificent water powers which exist in so many areas and develop their local resources on the most advanced engineering lines.

ELECTRIC LIFT CONTROL—*

By H. Marryat

THERE are three principal methods of control of electric lifts, viz., hand rope, car switch, and push button.

Hand-rope control is the natural offspring of its hydraulic predecessor. Being the pioneer of electric-lift control, it has passed through a more complicated process of evolution than either of the other types. In the form in which the hand-rope controller has now settled down, it consists simply of a motor-reversing switch, operated by the hand rope, which passes through the car. An additional contact upon this reversing switch closes the circuit of a solenoid, which actuates a plunger attached to a rheostat, so cutting the starting resistance out of the armature circuit. To prevent this action taking place too quickly, a dashpot is employed to retard the motion of the plunger.

The car-switch controller acts upon precisely the same principle, excepting that the hand rope is replaced by a car switch, the contacts of which are connected by a flexible cable, so as to operate the motor-reversing switch by means of solenoids. Sometimes the car switch is provided with additional contacts to provide a second or even a third speed. This speed variation is effected by solenoid switches acting upon the field circuit of the motor. Usually, a field rheostat with solenoid-dashpot control is employed. In order to allow of the wide difference in speeds, which alone can be of very much value in an electric lift, the motor of a two or three-speed lift must be very much larger than in a corresponding single-speed lift. Two-speed lifts are particularly useful for hospital installations, when the high speed can be used for the doctors and nurses, and the low speed for transporting the patients.

Here let it be noted that electric lifts present the paradox that the size of the motor and gear is, to a large extent, independent of the speed of the lift. For instance, suppose a lift designed for 1-ton load at 100 ft. per minute requires a motor and a gear of a certain size, the same motor will run the same lift and raise the same load at 200 ft. per minute, provided only that the motor winding is so altered that the motor runs at twice its former speed. There is, therefore, no occasion for any very great difference in the price of a lift upon account of speed.

Push Button Control

A push-button controller consists of a main panel, precisely the same as that used with a car-switch controller, but, in addition, there is a relay panel and a floor-selecting switch. Separate circuits having a common return operate the controller from the push buttons situated on each floor, or in the car. Each of these circuits includes a relay upon the relay panel, and also passes through the selecting switch. When the button corresponding to a particular floor is pressed, it first closes the circuit of the solenoid of a small relay switch, of which there is one for each floor. This relay operates the main reversing switch, and the lift starts. When it arrives at the floor in question some device short-circuits the relay switch for that floor, and accordingly the lift stops. The device referred to may be a switch fixed in the lift well, and operated mechanically by the car. Such an arangement works admirably, excepting that the floor switches, however they are designed, make a clicking noise as the car passes them. This is a condition which is very undesirable in buildings where people sleep at night, and an abominable annoyance in many hotels.

Floor Selecting Switch

An alternative arrangement is available with drum-driven lifts. In this case, a floor-selecting switch, somewhat similar to a drum-type controller, and having contacts corresponding with each floor, is geared direct to the main shaft. As the lift travels, this switch makes a serie of contascts relating to the several floors. When the car reaches the floor at which it is predestined to stop, the selecting switch will reach a position where the relay for that floor is short-circuited. This system is not practicable with sheave driving, because of the creeping of the ropes on the sheave which sometimes amounts to many inches a day. To get over this difficulty, that is to say, to combine the advantage of the selecting switch with the sheave-driven lift, an arrangement was patented by the author's firm by which the selecting switch is driven directly from the car itself by means of an auxiliary steel wire cord fixed to the car, and anchored to a drum runing free on the main shaft. Another similar cord, also anchored to the same drum, is attached at its other end to the counter-weight. A sprocket wheel on this light grooved drum drives the selecting switch by means of a chain. This arrangement has proved completely successful.

On the push-button board in the car, a special ''stop'' button is usually provided to enable the passenger to stop the car and re-start in the event of his wishing to correct an error of having pressed the wrong button. This ''stop'' button is connected in the door-contact circuit, and opens the main solenoid circuit. Usually only one push is provided upon each landing to call the lift to that floor, but sometimes, particularly with goods and service lifts, a complete steering board, that is, one containing a push for every floor, is fixed upon each of the latter. With this system the car may be called from, or sent to, any floor from any floor.

Dispensing With Attendant

Where a push-button controller is installed, it is usual to dispense with an attendant. This necessitates the introduction of various safety devices, because the doors formerly locked and under the entire control of an attendant, are now in the hands of any person desirous of using the lift. It must be impossible to operate the lift whilst any door is open, and it must be equally impossible to open any door excepting when the car is opposite the floor in question. This apparently simple problem has not proved easy of solution, and there are comparatively few lifts running at present which fulfil the conditions perfectly. All the landing firms of lift makers have worked at this problem, and have produced locks more or less satisfactory.

It is a similar matter to arrange a door contact so connected that it is not possible to start the motor until every door is closed. It is equally easy to design a door-lock which can only be opened when the car, opposite the floor in question, releases the lock by means of a cam truck fixed on the car for the purpose. The difficulty is to combine these two features so that the door cannot be closed just close enough to make contact and yet not lock, or, on the other hand (supposing you have set your contact to meet this difficulty), to just lock and yet not make contact. One of the conditions which a really good lock must satisfy is that it shall not allow the door to open if it be pulled at the moment when the car is passing in its travel up or down the building. It is true that if this is done the car will stop owing to the door contact being broken, but the possibility of such an interruption and delay causes as much annoyance to passengers as it does amusement to small boys.

Self-closing door springs of a type which will close when left only an inch or so open, and yet never bang, are a desirable feature of an automatic lift, if it is not intended to keep a boy continually running up and down stairs closing doors after thoughtless passengers; for, be it remembered, if one door is left open the least amount, the lift cannot be used until it is closed.

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Electricity, as a street illuminant, was introduced to Canada at the Canadian National Exhibition in 1882.

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*From a paper read before the Association of Supervising Electricians.

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PETER BAIN, M.E., Editor. B. G. NEWTON, Manager.
Associate Editors,
A. G. WEBSTER J. M. WILSON
J. H. RODGERS
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THE 1916 CANADIAN NATIONAL EXHIBITION.

THE forthcoming Canadian National Exhibition gives promise of recognizing to a greater extent than has any of its predecessors the place and part that our metal-working industries fill in our national progress, and in turn reflect on our international status. As will be noted from the programme of this year's now imminent annual display, there has been arranged to feature, in manner becoming our manufacturing enterprise and achievement, the production of shells and shell parts from their minutest detail right up to the stage of complete assembly for service in the field.

In arranging to recognize in this special manner what our metal-working plant executives and operators have, during these twenty months or more, accomplished on behalf of our Empire, the Exhibition management are to be congratulated. It goes to show that, although the machinery and power side of the Exhibition scheme of things has in the past been somewhat secondary in importance, if steps be taken—and the time never was more opportune, to erect a Machinery Hall commensurate with the scope of the metal-working industries and with the reputation of the Exhibition as an educative and nation-building enterprise, the myriad industries concerned—large and small, will be found ready and willing to annually tax such a building to its fullest capacity with worthy examples of craftsmanship.

The European War has opened up to us new fields of commercial endeavor, but back of commerce we must have industry, and the latter must needs have inspiration to keep it progressive. The Canadian National Exhibition as an annual institution may well provide the inspiration for our industries. Few of our manufacturers would now be disposed to rest on their oars to the extent of allowing exhibits of one year to remain publicly and be in a market sense outclassed by a competitor in the succeeding year. Whatever of that nature has prevailed in the past, the new vision of accomplishment and the new appreciation of capacity that have come to us, make repetition absolutely impossible.

Incidentally, we might say, that munitions manufacture in Canada, and the coming display at the C.N.E. constitute an inspiration to the Exhibition executive, and one which is perhaps more forcefully expressive of the need for a new Machinery Hall than the much urged action towards same to which they have become so well accustomed, particularly around Exhibition time in recent years.

OUR PRESENT INDUSTRIAL PROSPERITY

THE piling up of bank deposits in Canada continues unabated, and, as a phase of national strength, may be said to augur well for our bearing somewhat comfortably the war-imposed burdens already effective and those yet to be enacted. It must be admitted, however, that our financial strength arises largely from the widespread production of munitions by our manufacturing plants to order of Great Britain and her Allies. Further, our reasonably satisfactory trade balance has its foundation and superstructure centred also about munitions. There is nothing, of course, undesirable about such a state of affairs, provided its maintenance had even some degree of permanecy, for then, even with heavy imports against us, we might still easily keep "afloat" so to speak.

Fortunately, in the most desirable sense of the term, this munitions business is only temporary; but are we acting as if it were so. We have talked of new opportunities for export trade and the capturing of former German trade which is both domestic and export, yet seem to have accomplished little in either direction. Our imports are increasing by leaps and bounds, aside from raw material requirements for munitions, and just where we will ultimately land unless we call a halt and proceed to manufacture, instead of continuing to buy "ready for service," the "gods" alone can supply the answer.

The export opportunities for Canadian plants with organizations, equipment and product to take advantage of them are numerous, and not a few of our industrial enterprises are already and profitably thus engaged. The question naturally arises are our myriad other firms, unadapted for export business, doing their part in keeping imports at the absolute mimimum. It appears to be fully established that they are not, particularly as far as Western Canada is concerned. From apparently reliable sources the manufacturers of Eastern Canada are not even recognized as competitors in the market for Western business.

Export opportunities, as already stated, were never so attractive and inviting. Offsetting imports by meeting their variety production with the new capacity that munitions manufacture has engendered is equally attractive and inviting, while at the same time never more necessary of becoming operative.

The general industrial situation continues very satisfactory. Factories working on war orders have as much business as they can conveniently take care of especially in view of the scarcity of skilled labor and, in many cases, shortage of raw materials. Munition plants have sufficient business on hand to keep them operating at capacity for many months and further contracts have been assured by the action of the Dominion Government in establishing additional credits on behalf of the British Government. These contracts will represent heavy tonnages of steel and result in considerable activity in the trade. A statement recently issued by the Department of Trade and Commerce, Otatwa, reveals the big advance which has been made in Canadian trade during the first three months of the present fiscal year, April to June inclusive. The statement shows an increase of more than 93 per cent. in the grand total for the above mentioned three months. The volume of trade aggregated $527,512,344 as against $272,646,868 for the first quarter of the fiscal year of 1915. June was an exceptionally good month, the exports showing very heavy increases in manufactures, in agricultural and in mineral products. The figures in the report are very significant and prove conclusively that the country is enjoying an era of prosperity never before experienced.

The Operators' Point of View

CENTRAL POWER AND HEATING PLANT ADVANTAGES

By T. W. R.

GROUPS of old buildings frequently contain many and diverse plants for the development of power. These are often made up of boilers in bad condition, and in connection with which the question of replacement is considered annually by the owners. The following reasons should be given due consideration in the deciding of such questions, having in mind the displacement of these scattered sources of power together with their transmission auxiliaries by a central plant installation, the cost of which may be met by its many advantages as herein outlined, or in part by the cost of the old boilers otherwise replaced or bearing considerable maintenance charges.

The damage to property or loss of life through explosion or other accidents, liability to fire, and the handling of ashes and coal with its resulting dirt, annonyance and labor are all confined to one point. The supervision of the plant as a whole is much easier and more effective.

Continuous and steady supply is secured in comparison with the isolated plants which are generally run intermittently with consequent loss of fuel and time in starting and shutting down.

A reduction in the cost charges for future buildings is obtainable by the elimination of additional boiler plant structures with their boiler and coal rooms, chimneys and equipment, also a reduction in the insurance rates for all new and existing buildings.

A direct saving is procured through the installation of economical devices installed because of the magnitude and importance of the central plant, and which were formerly given but slight attention or were considered as being disproportionate to the size of the old plants.

A more capable superintendent can be engaged whose expensive salary could not be formerly considered. Two or more skilled firemen and in general a more desirable class of labor can be employed, thereby maintaining a plant in good condition with lower charges for depreciation and maintenance. A reduction in the number of operators required is also possible.

Small plants invariably mean small boilers, and small boilers mean more scale and dirt deposit than is found in large boilers. Similarly the latter are more efficient. More coal can be burned per square foot of grate surface per hour, with a more efficient combustion due to its higher rate. Various costly items may be eliminated, such as the consumption of gas for heating water baths in scattered buildings, and which may under the new idea, be piped and supplied with steam from the central plant. There will be a lesser amount of radiating surface from boilers set in battery as compared with that of the single boiler installation. Boiler settings of small plants frequently give further losses because of their poor condition.

In mild weather the fires of all boilers in the scattered plants must be kept low. One boiler in efficient operation in the central plant may be all that is required. There is a saving in the cost of ash removal. The use of exhaust steam for heating is often more readily made possible through the centralization of steam using machinery.

Finally, there is the matter of convenience as opposed to the loss of heat in transmission to the various buildings. The latter disadvantage of the central plant is but a slight factor provided an effective covering and a good form of sectional conduit be used.

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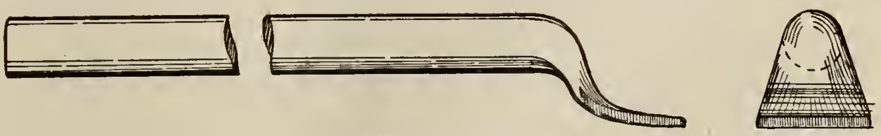
HANDY FIRING TOOL

By J. Thorn.

THE bar shown was made as an experiment, 1¼ in. or 1½ in. pipe being used, and the end of the pipe heated and bent as shown.



HANDY FIRING TOOL.

In firing light with screenings it breaks up the front bank and forces just about the right quantity of unburned coal back, leaving enough behind to prevent the fresh screenings from going through the bars. In some cases it is better than the hoe and takes the place of both the hoe and the straight slice bar, but no claim is made that it can take the place of these old standbys for all kinds of fixing.

It only takes ten minutes to make it and it is a handy addition to the regular fire tools used in small plants.

* * *

VALUE OF BELT TIGHTENERS

By N. G. Near

WITH reference to the extracts from the report by Professor W. W. Bird and Francis Roys in your last month's issue, it might be well to point out the fact that these tests were made on belts that had not been waterproofed. Humidity does not affect a waterproofed belt to any appreciable extent, if at all.

I do not find any reference to the ommission of this important point in the report of the above gentlemen, and therefore think it should be added, otherwise erroneous conclusions might be drawn. Readers are liable to think that leather belts are subject to change with humidity, but such is not the case as has been proved time and again with waterproofed belts. With a properly waterproofed belt, slipping does not occur when humidity increases. Of course, should humidity increase to such an extent that the pulley would become wet, the water on the pulley might serve as a lubricant and slipping would occur, but that would be a very extreme case and is seldom experienced in practice with belts used indoors.

Another point missed in the above report is the advantage of pliability with waterproofing which permits the belts to be run slack. High initial tensions become unnecessary. In that case, then, there is seldom any need for belt tighteners except on vertical or overpull belts. In fact, I wouldn't call them belt tighteners at all. I would prefer to call them "idlers" because the function of an idler should be principally to increase the arc of belt contact to a maximum rather than to "tighten" the belt. Arc of contact, with a good reliable belt, is more important than tension as can easily be proved by taking a "hitch" around a pulley with a pliable belt, and then with a stiff, dry belt. The pliable belt will hold, but the stiff dry belt will slip.

* * *

ACTIONS IN EMERGENCIES

By J. Hamilton.

WHAT a person would actually do in a case of emergency is a debatable question. We are all prone to believe that we would or could control our actions under certain conditions; but in many instances an exactly opposite effect has been the result. The reaction of the nerves, due to any sudden news or local disturbance, so affects the brain of the average person, that they are plunged into a state of semi-panic or bewilderment, with a temporary loss of thinking power; consequently, predetermined actions are forgotten, and we are forced to obey a power, over which we apparently have no control. The spirit is often willing, but the flesh is nearly always weak.

In a large factory some time ago the main belt from one of the motors broke, striking and destroying one of the water sprinklers. If the men in the shop had been told that this particular mishap was expected, they may or may not have acted differently, but what did occur was equally as sudden and complete as that of the breaking of the belt, with the subsequent distribution of dust and flying water. Without a thought of what had happened, the entire gang of men, with the exception of the foreman, stampeded for the doors, falling over themselves and others with the one object of reaching the outside. However, they were no sooner outside than the "gray matter" began to settle, and, returning to the interior, they found the foreman (somewhat unstrung) watching a gradually decreasing flow of water from the broken sprinkler.

Bravery Under Fire

An interesting test was recently made to determine the stability of a young lad who had been continually saying what he would do under certain conditions. The question of bravery under fire of shot and shell was being discussed by several men in the shop, and this young fellow intimated that he could stand up to the ordeal alongside of anyone; so to show the others and prove to him the fallibility of the majority of humans, we chose a time when he was absent from his lathe, and, taking the heavy or "light" end of several parlor matches, inserted them in the large gear of the back shaft, the matches being secured by a small quantity of belt dressing. When he returned to his lathe and pushed over the shifter, the effect of the "machine gun" can be well imagined. Where the blood had gone to is doubtful, but it was certainly not in the "pale" of his face.

* * *

CHART FOR FINDING WEIGHT OF CAST IRON PIPE.

By N. G. Near.

THE accompanying chart will be found useful for determining the weight of cast iron pipe or cast iron columns. It is not necessary to do any computing at all. For example, what would be the weight of a cast iron pipe 30 ft. long, with a dimension D of 24 inches, and a thickness of one inch? The dotted lines drawn across the chart show how it is done. First connect the 30 (column A) with the 1 (column D) and locate the intersection with column B. From this point of intersection run straight to the 24 (column E) and the result is found in column C. The weight is practically 7000 pounds.

It will be noted that the range of the chart is very wide and will give the weight of a total length of all ordinary sizes up to 1000 feet. For rough estimating work this chart will be found hard to equal.

CONSIDERATION OF ASSISTANTS

THERE are two principal ways for a engineer and his assistant to work together. One kind of a chief works very hard himself and does not leave much of importance for his assistant to do. The other kind lets his assistant do all he can while he reserves his own time and thought chiefly for things the assistant cannot do—at least, cannot do so well. He puts responsibility on his assistant just as fast as the assistant shows his ability to take it.

The first named retards his own growth and that of his assistant. He is always over-worked and has little or no time to think of new things . He is often doing work that should have been done several days before. His assistant either chafes under the restraint, or concludes that he is incompetent, and settles into a dull mediocrity.

The second type has time and opportunity to grow, and gives his assistant room to grow also. The assistant feels his own strength, and loves his work. He shoulders the responsibility with eagerness, and the work goes merrily on. Ask yourself, which is best.

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Dr. J. O. Orr became general manager of the Canadian National Exhibition in 1903.

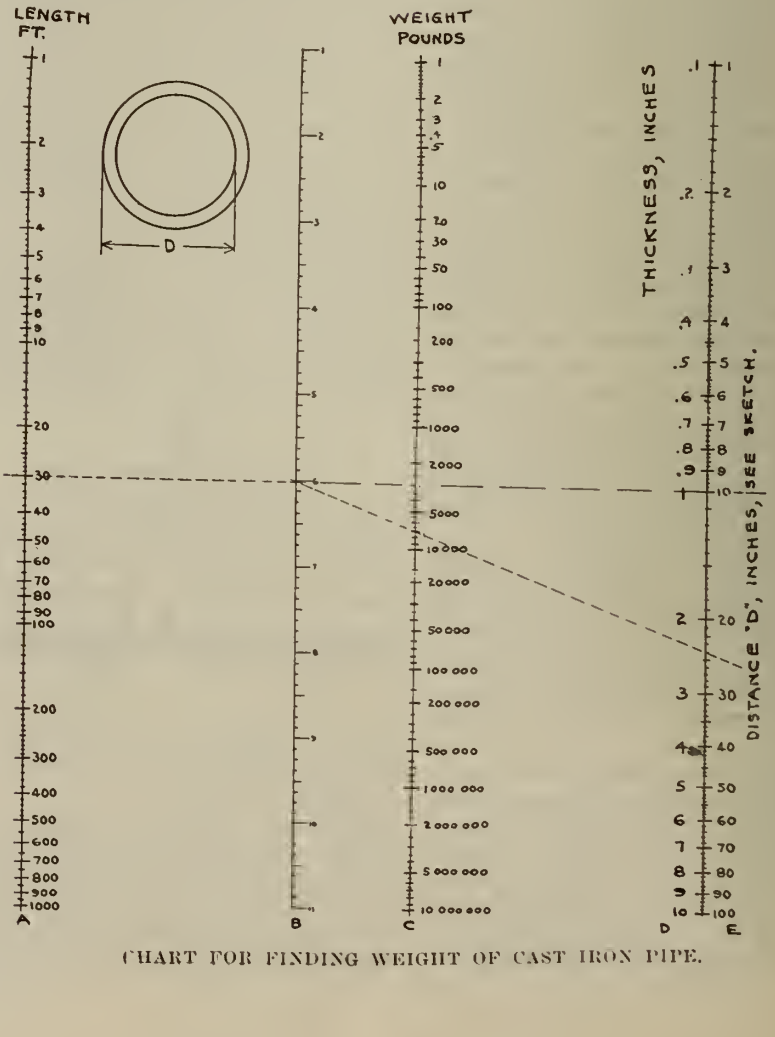


CHART FOR FINDING WEIGHT OF CAST IRON PIPE.

Operators' Instruction Course

THE STEAM BOILER—VIII.

IN previous articles of this series, the subjects of combustion, smoke prevention, forced, induced, and natural draft have been discussed more or less comprehensively. It would appear, however, that the relative value of the steam jet among other devices and arrangements installed to aid combustion and eliminate smoke is not yet too clearly defined, in evidence of which we are reproducing the following contribution received recently from one of our subscribers. What the latter has to say on the subject of the steam jet in smoke prevention will appeal, we are certain, to a wide circle of our readers. We shall in consequence be glad to receive for publication in future issues such illustrations and data, indicative of success or otherwise, as any may be in a position to submit concerning the matter.

The Steam Jet in Smoke Prevention

Does the steam jet smoke condenser aid combustion? is a question to which I would like to have a correct answer. I would also like to know under what circumstances it is advisable to install the device? Mr. Thorn, in the December 1915 issue of The Power House, claimed success with a steam jet after some smoke consumers had given poor satisfaction; he also claimed that there was no increase in fuel consumption. Another writer some time ago spoke favorably of a steam jet smoke consumer in which the nozzle was inserted in an iron casting placed on the bridge wall, thus causing the steam to become superheated before contact with the furnace gases. Wm. E. Barr, M.E., in his "Combustion of Coal," 5th edition, refers to the unfavorable attitude of railroad men to the jet device, but on page 105 points out that carbon mon-oxide, CO, is more easily ignited in the presence of moisture than when dry. I will quote him later. Henry C. Tully, in his handbook, 6th edition, page 542, referring to the subject, states that, given two boilers with separate furnaces, having four steam jets in each furnace and each jet of 1-16 inch in diameter, the steam pressure being 100 lbs. per sq. inch, and the regulating valve wide open, the flow of steam through the eight jets will be 1,739 lbs. (nearly) in 12 hours. On the next page he says, "Taking a high-speed automatic cut-off engine using 20 lbs. of steam per horsepower hour, the eight jets will waste enough in 12 hours to run a 10-h.p. engine for $8\frac{1}{2}$ hours; one of 20 horse-power for $4\frac{1}{4}$ hours; one of 40 horse-power for $2\frac{1}{8}$ hours; and one of 80 horse-power for 1 1-16 hours.

Having never required its adoption, I took very little interest in the device until lately, when the variety of apparently conflicting opinions attracted my attention, and although not an authority on the subject, I am of the opinion that there are circumstances under which the jet is desirable, but that under ideal furnace conditions it is not advisable. I also favor the opinion that where the jet diminishes the smoke nuisance, the steam it uses is partially replaced by more efficient combustion. I shall try to give briefly the arguments by which I arrive at this conclusion, although it is partly with a desire of myself to learn under what conditions the use of the jet is profitable that I am writing. Perhaps some one will point out my errors and put me wise.

Again, now may be a good time for many of us who have smoky furnaces to deal with to again consider Mr. Thorn's smoke consumer, if it has not already been adopted, as described in his article in The Power House of December, 1915, pages 335-6. Without permission and for the benefit of any who may not have the original article on hand, I quote the following:

Thorn Steam Jet Smoke Consumer

"To satisfy him . . . we tried out" some of the patented devices for reducing smoke, but the percentage of improvement was so small as to be of no practical value. Our grate surface is small, being of 20 to 30 sq. feet to each boiler, so as a last resort I attached a small steam jet over each fire with astonishing results. . . . We have reduced smoke duration of from 15 to 18 minutes to something like four minutes, which is going some. The jet is simply a $\frac{1}{4}$-in. pipe with a flattened end so as to throw a fan-shaped discharge. It enters the furnace at the centre above the fire doors. A $\frac{1}{4}$-inch globe valve outside is opened for a minute or so at each firing and then closed."

Mr. Thorn has evidently taken a device not in general favor, applied it to his own furnace in his own way, and made it a success. I pay him my respects. Now obviously where little or no smoke escapes no smoke consumer is necessary, but some who are troubled with smoke may neglect to give this device a trial and simply because of adverse criticism regarding the steam jet smoke consumer; forgetting that very much depends on local conditions, and also that perhaps the installation that failed was installed where the conditions were less favorable to its success than they are possibly in our own particular plant.

G. A. Robinson, in a paper on "Smoke Consuming Apparatus," read at the 8th Annual Convention of the Middle States Ice Exchange, April, 1912, and reproduced in The Power House, advised that they were using nozzles made from $\frac{3}{8}$ in. piping drawn down until the opening in the end was only $\frac{1}{8}$ in. in diameter. Briefly these nozzles were screwed into a header passing along the boiler front, and were enclosed in pipes of $1\frac{1}{2}$ in. in diameter passing through the boiler front and front wall of furnace. The jets were placed as high above the fire as the boiler would permit, and inclined at such an angle as to point at the rear end of the grate bars. Four to six jets to each boiler were installed, according to the horse-power, and so arranged that one was directly over each fire door. The steam supply to the jets is controlled by a butterfly valve, connected to a dash-pot operated by water, the supply valve of which is controlled in turn by the fire door. He concludes: "We find this smoke consumer very satisfactory, easily adjusted to suit load and coal conditions, cheap to install, and simple in operation. I see, however, no remarks or comments regarding the effects of this consumer on fuel consumption.

The Railroad Viewpoint

The Western Railroad Club, U.S.A., discussing smoke prevention, concluded that "the steam and air jet cannot be considered as a promising source from which any successful smoke preventer may be evolved," and railroad men in some Western (U.S.) cities have concluded that "steam jets and other similar devices are not to be seriously considered as smoke preventers, and that the most effectual method of preventing smoke is by the use of the brick arch and skilful firing.'' Regarding this, is it not possible that a smoke preventing device unsuitable for a locomotive with its differently constructed furnace, practical absence of flame bed, smaller tubes and more intense draft, may quite possibly be O.K. for use with a stationary boiler furnace.

Argand Blower

Many devices unsuitable for locomotive practice are used to advantage in stationary plants. The Argand blowerer, for instance, uses a steam and air jet introduced below the grates. The steam softens the ash, thus permitting the air to pass more uniformly through the grates than if it were forced to find its way between clinkers too hard for it to pass through. When burning fine fuels, culm or screenings and using the Argand blower, it is important to keep the damper in the stack open only sufficient to prevent the fire passing out at the fire doors when they are open. By this means complete combustion takes place where it will do good, whereas with forced or induced draft up the stack much of the gas would at times be drawn from the furnace before it became ignited. I cannot imagine any such method being a success in locomotive practice.

Steam Loss Computation

Someone may assume certain internal areas for the nozzle and compute the pounds of steam which will escape per minute or per hour of total operation. then figure how much coal that steam represents, and, looking at it from this viewpoint only, abandon the project as costing too much in fuel. To thus figure the amount of steam is commendable, and if the device is installed will do much to obviate its use in an extravagant manner. Possibly, Mr. Thorn's success is to some extent due to steam economy secured by his use of a flattened nozzle spreading the flow more than would be done by the use of a plain round nozzle throwing a solid jet containing more steam, but exposing less surface immediately above the fire.

Someone else may believe that the steam will have a dampening effect, thus making a hot fire more difficult to obtain while really requiring a hotter fire to furnish the extra steam for the jet. Certainly steam admitted to the furnace without any air supply to accompany it would have a dampening effect, but at the risk of possibly deserving and perhaps receiving more criticism than the steam jet smoke consumer receives, I am going to claim that under conditions unfavorable for normal smokeless combustion small quantities of steam admitted above or below the fire may actually aid combustion.

Claims Aid to Combustion

Dampened fuel used under the same conditions would provide steam, but evaporation might take place too late to produce the best results. Steam can have no more dampening effect than an equal weight of water would; and, while it is generally conceded that the moisture in the fuel must be evaporated before useful heating effect can be secured for the boiler, yet the fact remains that certain fuels are more economically burned when sprinkled some time before using, and some locomotive firemen have been advised by their employers to use wet fuel as much as possible. Now, if evaporating the water from the fuel is just so much heat wasted, why moisten it? On the other hand, when some moisture is an advantage, owing to its mechanical effect, why may not some steam be beneficial if used instead? When using water on the fuel, it is easy to get too much, and the same is true of the steam; but, as every fireman knows, the regulation of the air for combustion requires judgment too, especially when admitted above the fire, for then, if not admitted in the proper quantity and at the right time and place, it may, by using B.t.u. to heat excess air needlessly, or by cooling some of the gas below the ignition point, cause as much waste as smoke would, and, to the experienced and alert fireman who has the air problem at his finger ends, the regulation of a steam jet is but one more step in the same direction as the regulation of the draft or of the amount of water, if any, on his fuel, and should soon come as natural to him. Visible smoke is composed of solid carbon particles, usually very light and small, and known as soot. In bituminous coals, the first effects of the heat is to break off these particles from the surface of the fresh coal next to the hot coals on the grate. If the furnace was hot enough and there was sufficient free oxygen above the fire for complete combustion, these particles would be converted into invisible gases; otherwise, they are carried out of the furnace and up the stack without becoming ignited. The products of combustion then consist principally of:

Carbon dust in the form of visible smoke; carbon monoxide (CO), colorless; carbon dioxide (CO_2), colorless; nitrogen (N), colorless; and possibly hydrogen (H), colorless.

Steam Jet Action

Now, if a steam jet reduces the amount of visible smoke, it is, by causing these carbon particles to become burned at least to CO, and it may be due either—(a) to their becoming so laden by the steam as to remain in the flame bed until ignited and combined either with oxygen of the air in the furnace or oxygen taken from the steam itself (in which case the liberated, unconsumed and invisible hydrogen of the steam would also be among the flue gases); or, it may be, (b) by supplying the required additional amount of oxygen, or (c) by causing a reduction of the CO_2 formed and using the oxygen to increase the amount of the CO until the free carbon is all or nearly so taken up. This last, while O.K. so far as the six-minute statute is concerned, is nevertheless not fuel economy, but if the CO formed by the combustion of the carbon, otherwise emitted as smoke, is additional to that which would have resulted without the use of the jet, and does not cause a reduction of the CO_2, then each pound of carbon so burned to CO yields 4,400 B.t.u. towards balancing the B.t.u. originally in the jet, and for every extra pound of carbon burned to CO_2 we have 14,500 B.t.u. to credit to the jet.

Theories as to What Takes Place

On the other hand, if, by the use of the jet, two pounds of carbon are burned to CO, thus yielding $4{,}400 \times 2 = 8{,}800$ B.t.u., where otherwise one pound would have been burned to CO_2, yielding 14,500 B.t.u., while the other pound escaped as an immense amount of black smoke (soot being very light); then, by using the jet, we reduced the smoke, but lost $14{,}500 - 8{,}800 = 5{,}700$ B.t.u. on those two pounds of carbon. It will thus be seen that both CO and CO_2 readings, and possibly H readings, are necessary in determining the true action in each individual plant.

For exact work I would prefer chemical tests of samples taken in duplicate, and both just before and after the jet had been turned on, an extended series of tests being made. Simple apparatus such as that of Bunte, or the more elaborate ones of Orsat or Hays, may be used. I do not think readings from an econometer depending upon the specific gravity of the flue gases for its variations, would be sufficient for tracing the exact effect of the jet. As evidence, however, that the absence of smoke is not secured by calling on CO_2 to yield oxygen for other carbon atoms, either owing to, or causing, a lowering of the furnace temperature, I mention the following points:—(1)—Black smoke is the product of a low furnace temperature. (2)—The accepted theory in steam and producer gas practice is that CO_2 is first formed, which later picks up another atom of C, thus forming CO. Obviously if the jet has already supplied that other carbon atom with its atom or two of oxygen, the first formed molecule of CO will remain as CO. (3)—That oxygen in steam will, in the presence of sufficient heat, liberate the hydrogen and attach itself to carbon, is shown by (Dowson) producer gas practice, and also by the production of generator water gas by passing steam through incandescent fuel (as in the Loomis-Pettibone system, for instance), and by the Mond process of gas-making. (4)—Referring to chapter 5 of "Combustion of Coal and Prevention of Smoke" (5th edition), by Wm. M. Barr, page 105, and under the question, "What are the properties of carbonic oxide," I find the following given as a portion of the answer:

Properties of Carbonic Oxide

"Carbonic oxide burns with a blue flame, which, by previous heating, becomes red, generating carbonic acid, CO. The temperature of its flame in air is about 1,400° C. When dry, it is not changed by the electric current nor by ignited platinum wire, but when standing over water it is decomposed by a glowing platinum spiral. When not absolutely dry, it may be exploded with oxygen by the electric spark or by platinum wire heated to 300° C., or by spongy platinum at ordinary temperatures. Two molecules of carbonic oxide, CO, unite with one atom of oxygen, O, to form two molecules of carbonic acid gas, CO_2. The combination takes place very slowly in the presence of small quantities of steam, and increases in rapidity with the quantity of steam present. Hence the steam acts as the carrier of oxygen to the carbonic oxide. Small quantities of other gases than steam have been tried. If the gas contained no hydrogen, no explosion occurred. When a mixture of carbonic oxide and steam is heated to about 600° C., a portion of carbonic oxide is oxidized. If the carbonic acid gas is removed as it is formed, the whole may be oxidized."

No Breaking Up of CO

These four points are all in favor of the theory that no breaking up of CO_2 occurs, and, therefore, if the jet reduces the smoke it is by actually aiding combustion. If there is in Mr. Barr's book any data giving a definite idea of the proportion of B.t.u. in the steam used, as compared with the heat evolved by the oxidization of the carbonic oxide during these experiments I have overlooked it, yet with regard to economy it is on this point that the commercial success of the plan turns. If oxygen and hydrogen in steam were dissociated by the agency of heat alone without chemical energy, 62,000 B.t.u. would be required to liberate one pound of the latter, and its combustion again would merely replace the heat previously expended in separating the gases. If water in the form of steam were merely a mechanical union of gases as air is, then 36 lbs. of steam (H_2O), containing 4 lbs. of hydrogen and 32 lbs. of oxygen, would supply sufficient oxygen for the combustion of 24 lbs. of carbon (atomic weight 12) to CO, thus producing 4,400 ×24=105,600 B.t.u., or for the combustion of 12 lbs. of carbon to CO_2=14,500 ×12=174,000 B.t.u. The total heat, above feed water temperature, in the 36 lbs. of steam, would be, say, 1,125°×36 =40,500 B.t.u., so that, allowing 70 per cent. for boiler efficiency, a 55 per cent. efficiency of combustion in the first instance or 33 per cent. in the second instance would replace the steam (36 pounds) used in the jet.

$$\frac{40{,}500}{70 \text{ of } \frac{105{,}600}{100}} = \text{approx. } 55\%$$

$$\frac{40{,}500}{70 \text{ of } \frac{174{,}000}{100}} = \text{approx. } 33\%$$

One hundred and thirty-nine lbs. of air would supply the same oxygen as the 36 lbs. of water contains, but there would be 107 lbs. of nitrogen to heat to blue gas temperature, say, 580 F.,° more or less.

Local Condtiions Important

For simplicity the specific heats and theoretical temperatures of the flue gases are omitted. Local furnace conditions will do more to vary and determine final results. In practice the efficient combustion mentioned above will not be obtained. To secure the best results the jet itself requires skill in its manipulation. The union of carbon with the oxygen of the steam is not a mere mechanical one, and only a proportion of the steam admitted becomes sufficiently decomposed to yield oxygen for combustion. In the Mond process of gas-making, 2½ tons of steam is admitted per ton of coal used, and only a half ton of this, amounting to 20 per cent., becomes decomposed. Therefore, while the jet is not to be recommended as a permanent substitute for desirable or necessary furnace alterations, yet if it sometimes make possible easily keeping within the six-minute mark where it could not otherwise be done without difficulty, then a smoke consumer is required and a trial of this device will not cost much, and I think the experiment will be worth making. Another point governed by local conditions is that where the working season of the plant is exceptionally short some waste by use of the jet may not really exceed the amount of the interest charges and other items in connection with the outlay necessary if the furnaces had to be, or were, remodeled instead. All these possibilities, however, must be determined by the men on the job, as they alone know all the circumstances and can judge and choose accordingly. Among other arguments that could be advanced as favoring the theory that small amounts of steam may aid combustion, the following might be mentioned:

Combustion Aid Arguments

The success of the water gas enterprises speaks for itself. In ordinary producer gas plants steam is generated in a vaporizer and, along with the draft, passes through the fuel bed, but as more air is admitted at the engine to produce complete combustion, the internal combustion engines using liquid fuel may be more illustrative of the point in question. Probably most of us read a year or so ago the story of an operator testing out a new gasoline engine and occasionally supplying extra gasoline to the carburetor by means of a squirt can, then sending a helper to refil the can. The engine had previously been giving out a black exhaust, but when the new contents of the can were administered the exhaust cleared immediately, the can having been filled with water by mistake. One "monthly" neglected to quote the story, but advised the frequent use of a little water thus for removing carbon from the cylinders.

When using kerosene for internal combustion engines (not Diesel), it has been found advantageous to preheat the oil and use a small amount of water spray, the effect of the water being to prevent both black smoke and abnormal heating of the cylinders. The Secor-Higgins carburetor is a successful device of the water supplying type proving the theory to be also good practice.

Various devices utilizing the exhaust to heat the intake air, and having two nozzles, one supplying kerozene and the other supplying a small quantity of water, have been used with good results. R. Desmarest, in the Scientific American, gave valuable pointers on the carbureting of heavy oils, but naturally much of the article can have only a remote bearing on the smoke consumer subject. In one paragraph, however, he says: "For a long while, in practice, chauffeurs have noticed the following facts: When the air is very humid it is necessary to diminish the quantity of air, while when it is very dry the proportion of air should be increased;" and farther on he says, "But the air that is borrowed from the atmosphere contains besides the oxygen and nitrogen, which is inert, a certain proportion of humidity—that is to say, of water or of hydrogen and oxygen in a quantity varying with the hygrometric degree of the air; therefore, the final mixture must be forcibly varied according to the quantity of water."

Relative Questions and Answers

I have before me a small pocket compendium, put out for advertising purposes by a manufacturing concern (not smoke consumer manufacturers by the way), and from it I quote the following questions and answers. Take them at your own valuation!

Question.—What is smoke?

Answer.—Unconsumed volatile matters separated from the fuel and carried up the chimney by currents of hot air.

Question.—Why does a little water make a fire burn fiercer, while a large quantity puts it out?

Answer.—A little water is readily converted into steam, which increases the heat of the fire, but water plentifully supplied is not converted into steam and stops combustion.

Question.—When will water extinguish fire?

Answer.—When the supply is so rapid and abundant that the fire cannot convert it into steam.

Question.—Why will not wet kindling light a fire?

Answer.—1st. Because the moisture of the wet kindling prevents the oxygen of the air from getting to the fuel; and 2nd, the heat of the fire is perpetually drawn off by the conversion of water into steam.

I see no questions about why a fire can be extinguished by a large enough jet of saturated steam under moderate pressure and at close range.

That a small jet is not objectionable when oil is used as fuel under a boiler is evidenced by the Prescott burner for oil, in which the oil tank is jacketed so that the oil may be heated by either steam or hot water, and in which there are adjustable openings for steam jets just below the oil nozzles, so that, in operation, steam under pressure comes in contact with the oil, thus atomizing it and carrying it into the furnace, where it meets the air required for combustion.

Steam-Creosote Fuel

From a back number of Popular Mechanics, whose shop notes have become popular, I quote the following regarding a (then) newly invented English process of manufacturing a new liquid fuel for automobiles. Speaking of creosote, the article says:—"When superheated and mixed with steam it is blown upon a rod of pure nickel, which acts as a catalyzer. A chemical reaction takes place incorporating into the oil hydrogen taken from the steam, changing the surplus of carbon in the creosote to a surplus of hydrogen, and thus making an ideal fuel. A later issue of the magazine speaks of a new discovery (in France) of a method of recovering 100,000 cu. ft. of illuminating gas from one ton of fuel, as compared with the customary 10,000 to 14,000 cu. ft. per ton. The article says in part:—"Primarily the new method consists of carbonizing coal in a common retort. Lime is mixed with it, and at the completion of the carbonization steam is passed over the coke, which is maintained at a temperature of about 1,700 degs. F. The lime acts as a catalyzer, converting carbon monoxide into methane. The action may be regulated so that water gas is not formed, while the yield of sulphate of ammonia is said to be greatly augmented, since most of the nitrogen in the coal is converted into ammonia. The discovery was made while watching the effect of steam upon carbon in the presence of lime. It was found that three distinct reactions took place, with the formation of hydrogen, methane, and ethylene." This latter looks to me much like the acetylene process with the electric furnace and the subsequent water treatment left out.

I notice that the words "catalyzer" and "catalytic," etc., are omitted from many common dictionaries, but the term "catalytic" is not a new one, it having been used by the medical profession for at least thirty-five years to indicate any remedy or remedies which seek to counteract a morbid material or process, and then pass out of the system without leaving an unfriendly trace or unfavorable token. The application of the term "catalyzer" to chemical agents in the processes described above thus becomes readily understood.

I was once working close to where an amateur mixer was melting together some fatty or oily and some resinous substances (I do not know the formula), when the mixture became too hot and ignited. The operator quickly removed it from the fire and watched it until the flame died out; then, believing the concoction to be useless, did spit in it, and immediately a flame shot up about 20 in. or two feet high, but died out again quickly. My curiosity aroused, I took over some water and poured a little on the stuff; again a blaze flashed up and died again, leaving black smoke rising from the vessel for a second or two. I repeated the water treatment several times, with the same results, except that the blaze was always in proportion to the amount of water applied, but later when the stuff became too cool to convert any of the water into steam no blaze resulted. I supposed at the time that after burning awhile the surface of the mixture no longer came in contact with sufficient air to support continued combustion, but that the water penetrating into the mass carried sufficient oxygen for a time and flame resulted so long as water was supplied and the temperature of the mixture remained above its own ignition point. Perhaps the amateur had accidentally included in the mixture some substance which acted as a catalyzer in the same manner as the nickel and lime mentioned in Popular Mechanics, thus causing combustion in the presence of steam, but I think that the phenomenon was natural and similar to smoke consumer practice.

More Data Wanted

There are many extremes in practical life. One man may be burning anthracite, containing 1 or 2 per cent. of moisture; another may be burning one of the moister lignites, containing 25 or 30 per cent. of moisture, and a third man may be burning a large proportion of sawmill refuse fresh from logs just pulled out of the water. This man, No. 3, may have more moisture in his fire without the jet than either of the others would have if using the jet. If someone will compile data that will enable us to, after considering class of fuel, grate area, size of combustion chamber, intensity of draft, etc., intelligently decide without experiment whether or not a steam jet will be an advantage in our own plant, and, if so, what style and number of jets to install; he may not only benefit himself, but I believe he will do a big favor for the profession. If, however, reliable data of this class has already been compiled for stationary engineers I shall be glad to hear of it through these columns.

HIGH AND LOW PRESSURE STEAM HEATING

IN a recent convention of engineers the heating question was discussed quite thoroughly, especially the value of low-pressure steam for heating industrial utensils such as glue pots, water heaters, etc. It was stated that high-pressure steam (30 to 60-lbs.) so much used heretofore is not necessary, and that low pressure is just as good, or even better, providing plenty of area is allowed in the pipes for moderate rate of steam flow, or plenty of heating surface is provided.

In one instance, where 60-lb. steam had been used, the pressure was reduced to 3 lbs., and, with vacuum stills, the output was actually increased. This was due to the fact that with high-pressure steam the steam blew through so fast that there was practically no time for condensation and heating. The lower pressure and lower steam velocity are ideal for stimulation of condensation.

It was further found that under high steam pressure twice as much steam was used as was absolutely necessary; the lower steam pressure reduced the amount consumed by one-half. Many instances were cited where, by changing the design of the heating systems — doubling the size of the jackets on the heating kettles, increasing pipe area, etc.—steam was saved to a marked degree and results were more satisfactory by using the lower pressure.

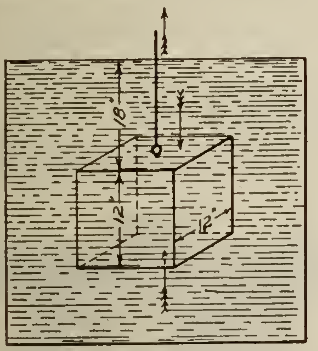
◆

The attendance the first year of the Canadian National Exhibition was 101,000. It ran three weeks. Last year there was a daily average attendance of 72,000 for 12 days, a total of 864,000.

Question and Answer Series

Question.—How is it that a body weighs less when submerged in water than when suspended in the air?

Answer.—If the specific gravity of the body is less than that of the liquid in which it is placed, the body will be only partly submerged, the displaced water being equal to the total weight of the floating body. When the specific gravity is greater than the water, it will be necessary to exert a force (as shown by the upper arrow) to keep the body from sinking to the bottom. Now, it is quite clear that the pressure of the water upon the sides of the block shown in the sketch will equalize each other, but the pressure on the bottom tending to lift the body will be greater, due to the larger head. The pressure acting downwards will be $12 \times 12 \times 18 \times .03617 = 93.75$ lbs., and the pressure acting upwards is $12 \times 12 \times \times 30 \times .03617 = 156.25$ lbs. Then the difference in this case will be the weight of the water displaced, or 156.25 minus 93.75 equals 62.5 lbs., which is the approximate weight of a cubic foot of water.



* * *

Question.—In the operation of a block and tackle, having a combination of pulleys, the weight is raised one foot while the free end passes through six feet. What force would be required to raise a weight of 350 pounds?

Answer.—From the above question it is seen that there are six ropes supporting the weight, therefore, the weight and the force applied will be in the same ratio as the supporting ropes and the free end, or 6 to 1. Then the power required to raise 350 pounds will be 350 divided by 6, or 58½ pounds.

* * *

Question.—We desire to change the volume of a flue to twice its present capacity. It is now 8 inches in diameter, and requires to be changed to one of oblong cross-section, the width being 8 inches. What must be the length?

Answer.—The area of the 8-inch diamter pipe will be $8 \times 8 \times .7854$, or 50.2656 square inches. Twice this will be 100.53 square inches. As this will be the area of the oblong flue required, the length will be the area divided by the width, or 100.53 divided by 8 equals 12.57 inches.

* * *

Question.—What are understood by the phrases "high duty" and "low duty" as applied to steam pumps?

Answer.—In a "high duty" pump, provision is made for expansive use of the steam by which the pump is operated; on the other hand in what is known as a "low duty" pump, boiler pressure steam or its equivalent is carried throughout the full piston stroke.

* * *

Question.—How would you increase the power derived from a throttle governor engine?

Answer.—There are two ways of doing this, namely, increase the speed and increase the mean effective pressure. As the governor is usually set to operate at its best working position, it is best not to change its speed from that for which it was designed. The better way is to increase the size of the pulley which drives it so that, while the engine would go faster, the governor would rotate at the same speed. To increase the power at the same speed, the throttle would have to open wider. This could be done without altering the working position of the governor by adjusting the throttle valve stem. The mean effective pressure can be increased slightly by decreasing the lead which will retard the point of cut-off.

* * *

Question.—What is the difference between a tube and a pipe?

Answer.—A tube is indicative of surface, a pipe of area. Example—A 3-inch tube will measure 3-inch outside diameter, while a 3-inch pipe will measure 3-inch inside diameter.

* * *

Question.—Are two 4-inch pipes equal in area to one 8-inch pipe?

Answer.—No. The 8-inch has an area double that of two 4-inch pipes. Doubling the diameter, therefore, increases the area fourfold.

* * *

Question.—A feed pump has to discharge 1,925 pounds of water per minute against a pressure of 90 pounds per sq. inch, and the area through the valves is 2 sq. inches; neglecting friction and loss from restricted discharges, etc., what would be the horse-power required?

Answer.—Since the fluid is water, the head corresponding to 90 pounds pressure equals 90×2.31, or 207.9 feet. The discharge per second will be $\frac{1,925}{60}$, or say 32 pounds, and since a cubic inch of water weighs .036 pounds, the discharge will equal $\frac{32}{.036}$ or 900 cubic inches per second. Also, since the area through he valves is 2 sq. inches, the velocity will be $\frac{900}{2}$, equal to 450 inches per second, or 37.5 feet per second, and the head necessary will be $\frac{37.5^2}{64}$ or 22 feet. The total head in feet will be 230 and the horse-power will be $\frac{1925 \times 230}{33000}$ or 13.4

* * *

Question.—An air pump having a piston 10 inches in diameter is designed to work against a pressure of 15 pounds per square inch. The pump piston is operated from the end of a lever, the other end of which is pivoted to the engine frame, and the engine crosshead is attached at a point 12 inches from the pivot. If the total length of the lever be 32 inches, what force must be exerted upon it by the crosshead?

Answer.—Area of air pump piston is $10 \times 10 \times .7854 = 78.54$ sq. in. Total pressure upon air pump piston is $78.54 \times 15 = 1178.1$ pounds. The distance of air pump connection from the fulcrum is 32 inches, and the distance of the crosshead connection from the fulcrum is 12 inches. Force exerted by crosshead is, then, $\frac{1178.1 \times 32}{12} = 3141.6$ pounds.

Steam Power Plant Auxiliaries

STEAM TRAPS—I.

In most cases where steam is subject to condensation as in engines, pipes and various kinds of apparatus for power or heating, it is necessary to provide means whereby the water of condensation may be removed without any loss of steam. The device which accomplishes this is known as a steam trap, and consists of a valve automatically operated by suitable mechanism, which in turn is controlled either by the weight or volume of water passing through the trap, or by the difference in temperature between the water and the steam.

The three principal types of traps in common use are expansion, float and bucket traps. Each of these types is made with numerous variations of construction. As will be understood, expansion traps operate as a direct result of temperature change, while float and bucket traps depend on the action of the water either by displacement in the float type or weight in the bucket type. Various modifications of each type are obtainable for different pressures, but contrary to expectation, low pressure traps have a higher percentage of failures than traps built for high pressures.

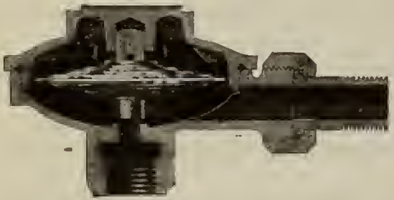


FIG. 1. DUNHAM RADIATOR TRAP.

In selecting a steam trap for any particular duty, every effort should be made to ascertain the probable load with some degree of accuracy. Two lengths of pipe or two pieces of apparatus in different parts of the same plant may have very different rates of condensation unless every condition be exactly duplicated in each installation. As condensation is caused by loss of heat, the rate of condensation for any one pipe or heating system will depend on the pressure, manner of operation, and exposure so that the ratio of condensation per lineal foot may easily vary from a few ounces of water per hour to as much as thirty-five or forty ounces. Bearing these conditions in mind, it is well to provide a trap of sufficient capacity to take care of the worst conditions liable to occur.

The size of the valve orifice is an all important feature, and should be specified whenever conditions permit. Orifices are frequently much smaller than the pipe connection size, and when small enough to prevent the passage of grit or scale, cause trouble due to the valve not being able to seat properly, with resultant leakage of steam and wire-drawing troubles. Trouble is also liable to occur when the water arrives in irregular quantities, which overload the trap temporarily, although the total water per hour may be well within the trap's capacity. See, therefore, that the actual maximum capacity is equal to this maximum temporary load.

Low Pressure Traps

The development of the low pressure trap has been almost entirely in conjunction with vacuum steam heating. Vacuum heating was conceived when the effort was first made to utilize exhaust steam from engines, etc., for heating purposes. It was a well known fact that as much as 90 per cent. of the original heat contained in the steam before expansion took place in the engine still remained in the exhaust steam emitted from the engine cylinder.

There were many obstacles to overcome to reach the present-day efficiency of vacuum heating. First—It was necessary to transmit this exhaust steam to the various radiators and steam condensing units without producing back pressure upon the engine pistons. That meant that friction had to be removed. It meant that circulation must be induced by means other than by the engine itself. The idea was then conceived to suck the steam away from the engine and into the different radiating units. This was accomplished by means of the steam vacuum pump, the exhaust of the vacuum pump itself being carried directly into the same exhaust piping system as that the engine.

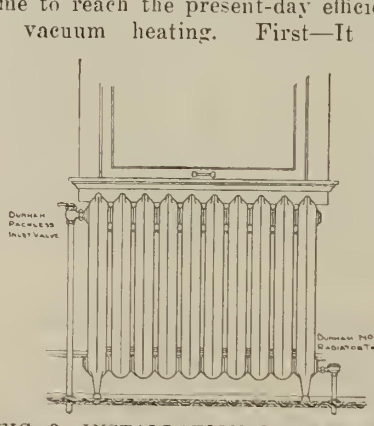


FIG. 2. INSTALLATION OF DUNHAM RADIATOR TRAP.

The application of the vacuum pump called for other vital improvements, the most important of which was providing some suitable device on the return end of the radiator to keep the steam from blowing directly through into the return piping system, for this caused short-circuiting of steam through radiators in the direct path of engine to vacuum pump, and the other radiators would consequently air-bind and be very inefficient.

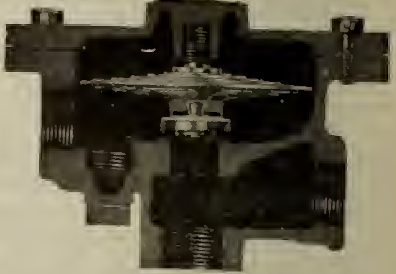


FIG. 3. DUNHAM BLAST TRAP.

It was thus found after years of experimenting with hand regulated devices on the return of the radiators, with semi-automatic devices, etc., that the real success of the vacuum steam heating system depended almost entirely upon the correct selection of the trap to perform the function of releasing the water and air from the radiators and closing off tight against steam.

The trap must be of simple construction, must be automatic over a wide range of temperature so as to close off for steam and open for air and water—whether the steam pressure in the heatinging system be 10 or 15 in.. of vacuum or 5 or 10 lbs. of gauge pressure.

At the present time it is well understood that this is the real vital factor —that low pressure traps on vacuum heating must be capable of working automatically on this wide range, yet at the same time be capable of passing foreign matter easily and continuously from the radiator without clogging up.

The thermostatic type of trap is one of the most widely used traps for vacuum heating of any of the various types offered to-day.

Dunham Radiator Trap

This trap (see Fig. 1,) is commonly known as the hollow, corrugated, thermostatic disc type. The trap body and cover is made entirely of brass and is so simply constructed that the water from the radiator has a gradual and direct flow to the opening in the centre of the trap body which leads to the return pipe. Directly over this opening is the only movable part of the trap. It is the member from which the trap derives its name — a hollow, corrugated, thermostatic disc, which is anchored rigidly to the cover of the trap. The corrugations in the disc add to the strength and the large diameter of the disc provides the maximum expansion of the disc with minimum strain per unit of area, with correspondingly long life.

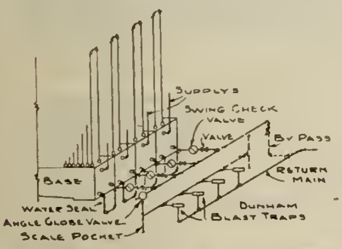


FIG. 4. INSTALLATION OF DUNHAM TRAPS ON BLAST COIL HEATER

The disc member contains a combination of volatile liquids which are hermetically sealed within and indefinitely retain their latent power of expanding and contracting in response to the effect of temperature. The disc is in contact with the steam and is subject to the same conditions that obtain within the heating fixture itself, an important factor in vacuum heating. On the lower portion of the disc is the flat valve which when steam surrounds the disc, seats on a flat surface of liberal area. The seat itself is raised slightly and this intercepts foreign matter, which usually collects around the raised seat until the trap opens, when all dirt and sediment is flushed through the discharge opening of the trap into the return pipe.

The disc forces the valve against its seat with a pressure of approximately 15 pounds which is sufficient to break up pieces of scale that might attempt to pass the trap. The large flat valve and seat admit of performing this severe service without injury to the seat, such as might happen to devices which use an otherwise sharp edge seat.

The disc member is made of a special phosphor bronze, and the same general design has been used by this company since the trap first appeared on the market some twelve years ago.

Dunham traps are made in the following sizes: ½ in. pipe connection, No. 1 size for 100 sq. ft. radiation; ½ in. pipe connection, No. 2 size for 350 sq. ft. radiation, the manner of installation being shown in Fig. 2.

The Dunham Blast Trap is constructed along the same lines as the radiator traps, except that it has an iron body. It is commonly used for removing air and condensation from steam mains or from blast heater coils.

The ¾ in. Dunham blast trap has a capacity for handling 1,500 square feet of direct radiation, and the 1 in. blast trap has a capacity for handling 3,000 square feet of direct radiation, or equivalent, a sectional view being shown in Fig 3, while Fig. 4 illustrates the method of application to blast coil heaters where exhaust steam is used in conjunction with a vacuum system.

⁂

HIGH EFFICIENCY STEAM ENDS FOR AMMONIA COMPRESSORS

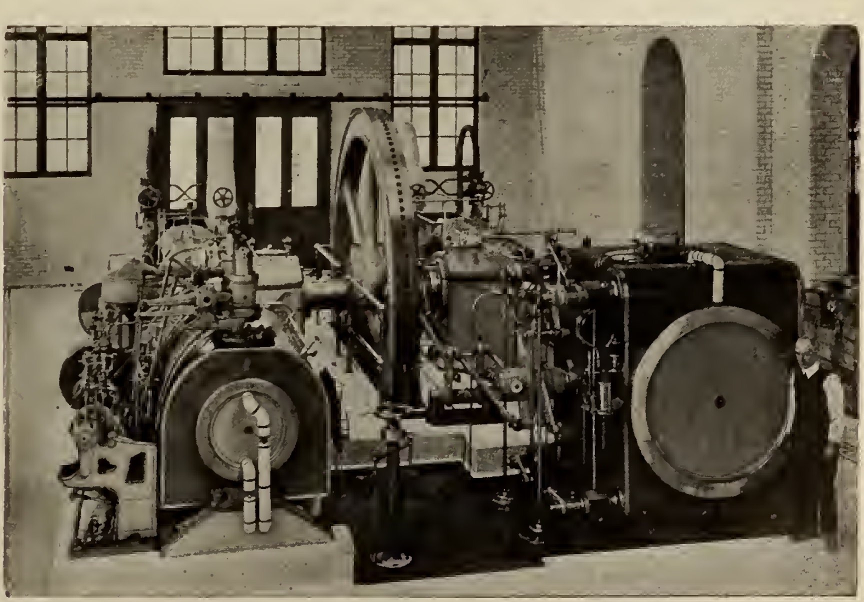
THE illustration herewith shows an ammonia compressor which was recently installed at the Old Colony Breweries, Fall River, Mass. The thermal efficiency developed at the acceptance test merits especial mention. As shown in the cut, the engine is a cross compound. The high pressure cylinder is fitted with double beat balanced poppet-valves, the valve gear being of the releasing type with spring dash pots. The low pressure cylinder has multiported Corliss valves with separate eccentrics for steam and exhaust. The builder's guarantee for the steam end of the compressor was that the steam consumption should not exceed 10.75 lbs per i.h.p. per hour at normal load of 420 i.h.p. under 175 lbs. pressure and 150 deg. superheat at the throttle, with 26 in. vacuum. The test was made under the supervision of representatives of the purchaser and the builder, and is summarized as follows:

Average steam pressure ...	174 lb.
Average steam temperature.	552.41 deg.
Average superheat	175.41 deg
Average vacuum at machines	26¼ in.
Revolutions per minute....	55.85
Average indicated h.p.	411.5
Total water per hour	4286.5 lb.
Condenser leakage per hour	211½ lb.
Net water per hour	4075 lb.
Steam consumption, lbs. per i.h.p. hour	9.914

The compressor was built by the De La Vergne Machine Co., New York, and the steam cylinders by the Nordberg, Mfg. Co., Milwaukee, Wis. The steam ends conform in general to the designs for combined Poppet-Corliss compound engines.

⁂

Explosions have occurred in connection with ordinary Lancashire boilers when hand-fired with wood waste or other bulgy material liable to rapid gasification. These explosions are due to the choking of the furnace by a close mass of the fuel, whereby the air is largely excluded from the fire, during the period when combustible gas is being distilled, while a moderate amount of air enters at the back end of the grate, or elsewhere, and becomes mixed with the gas. Such a mixture may accumulate until the fire burns through the fuel and effects an explosive ignition. In such a case the obvious remedy consists in avoiding the choking of the fire, by feeding in smaller quantities at shorter intervals of time.



HIGH EFFICIENCY STEAM ENDS FOR AMMONIA COMPRESSORS.

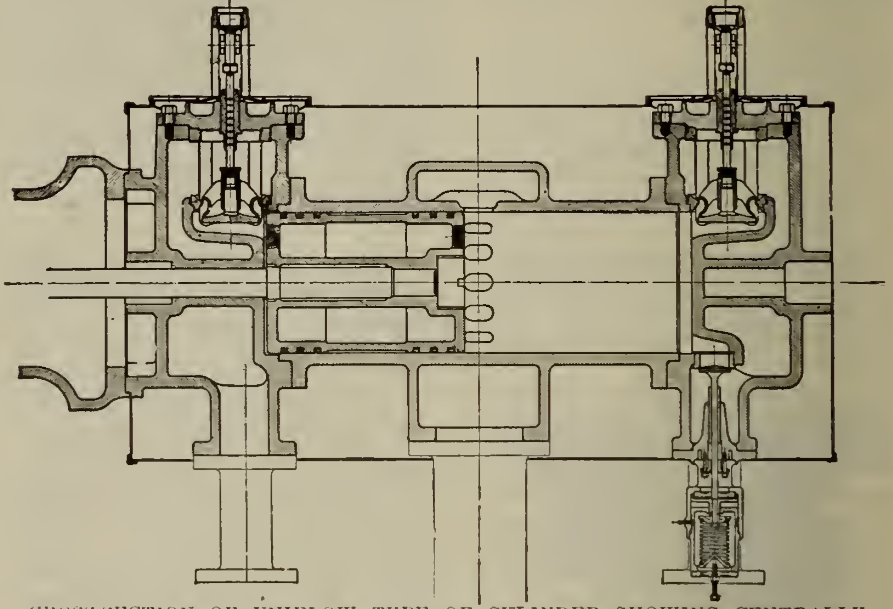
Progress in New Equipment

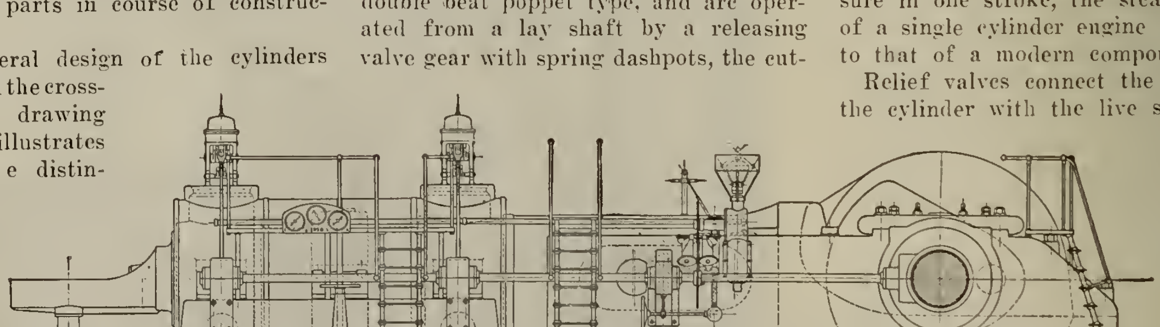
UNIFLOW ENGINES FOR DRIVING ROD MILLS.

THE merits of the uniflow type of steam engine are gradually compelling a wider appreciation of its capabilities. In the struggle for efficiency in power production, attention has been chiefly centred on the steam economy of this engine with a consequent lack of appreciation in regard to its conspicuous ability in another direction, viz. overload efficiency.

Without detracting from its increased general efficiency, one of the most desirable features of the uniflow engine is its capacity for extreme overloads with a flat steam consumption curve, tests having shown that 200 per cent. load can be carried with an increase in steam consumption of only 10 per cent. Such a fact renders this type of engine well adapted for fluctuating loads with high peaks such as rolling mills and electric stations.

The first applications of this type of engine to rolling mill service in America have just been carried out by the Nordberg Manufacturing Company, Milwaukee, Wis., for the Youngstown Sheet & Tube Company, Youngstown, O. Two engines have been completed and shipped, the larger one to drive a 12 in. rod mill, and the smaller a 9 in. rod mill, the accompanying illustrations showing the principle of operation and some of the larger parts in course of construction.

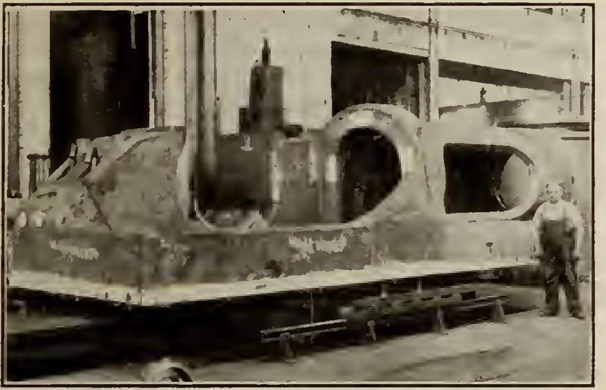

CROSS-SECTION OF UNIFLOW TYPE OF CYLINDER SHOWING CENTRALLY LOCATED EXHAUST PORTS.

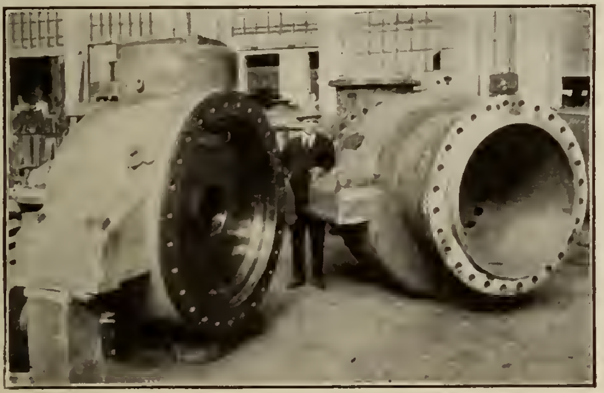

ELEVATION OF UNIFLOW ENGINE FOR DRIVING ROD MILL.

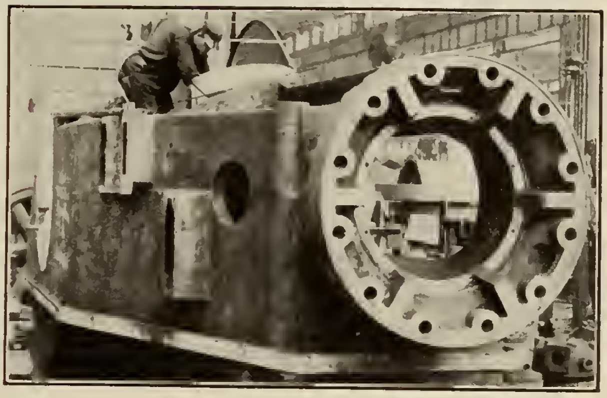
The general design of the cylinders is shown in the cross-sectional drawing which illustrates clearly the distinguishing features of design. Live steam is supplied to the interior of the two cylinder heads, which are duplicates in regard to general arrangement of passages, valves, etc. The cylinder proper is of plain tubular form having cast around its centre portion an annular passage, into which the exhaust steam from either end of the cylinder alternately escapes as the piston uncovers in turn a number of ports in the cylinder wall. The piston is of considerable length being not quite equal to the stroke, and is provided with rings at either end.

The steam admission valves are of the double beat poppet type, and are operated from a lay shaft by a releasing valve gear with spring dashpots, the cut-off being under control of the governor through the wide range of loads. As the only means of exhaust is through the ports referred to, the steam flows in one direction only, hence the name uniflow, consequently the ends of the cylinder are not cooled by the rush of exhausting steam which takes place at the point farthest from the ends. The temperature of the various parts, therefore, although it varies from the heads to the centre, is constant, and thereby renders the engine suited for a high ratio of expansion. Steam may be expanded from boiler pressure down to condenser pressure in one stroke, the steam economy of a single cylinder engine being equal to that of a modern compound engine.

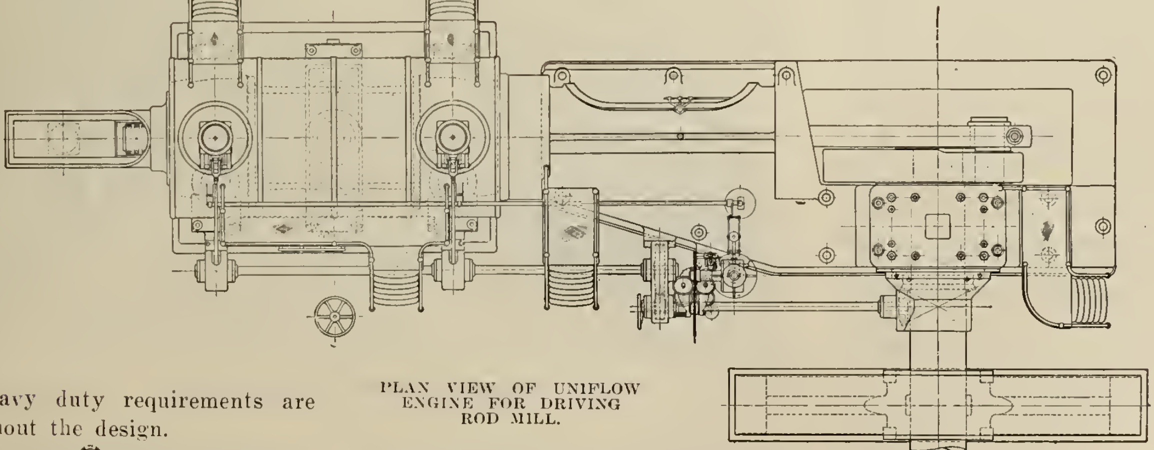
Relief valves connect the interior of the cylinder with the live steam space so that should an excess amount of steam remain in the cylinder due to loss of vacuum from any cause, the pressure resulting from this being compressed by the piston on the return stroke will force the steam back into the steam space without damage. These valves are on the lower side of the heads, and are of the poppet type fitted with a cataract dampening device. A feature of the valves is the absence of packing on the valve stems, which are accurately ground and lapped bushings.


BED OF 44-IN. DIA. BY 50-IN. STROKE UNIFLOW ENGINE BEING MACHINED.


CYLINDER HEAD AND CYLINDER FOR 44-IN. DIA. BY 50-IN. STROKE UNIFLOW ENGINE.


END VIEW OF FRAME SHOWING REINFORCEMENTS ON FLANGE WHICH CONNECTS TO CYLINDER PARTS.

The frame as will be observed from the illustrations, is of the horizontal Tangye type, with side crank and flywheel. Heavy duty requirements are met throughout the design.

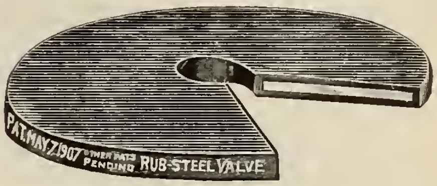

PLAN VIEW OF UNIFLOW ENGINE FOR DRIVING ROD MILL.

FRICTION CLUTCH RING TESTS

IN a recent issue of Alfred Herbert's Monthly Review an experiment is described which was made for the purpose of testing various designs of friction rings for use in the friction clutches of lathes. The ring being tested, was held by hooks and opened by lifting up by a crane or lifting blocks, the stress being measured by a portable weighing apparatus. The expansion of the ring under different loads was measured by dividers set to centre dots in the same way as the expansion of a tensile test specimen is measured. By this means it was possible to obtain for each ring a record of the different expansions under various loads, which could be plotted in the form of a stress-strain diagram, and records were also obtained of the final breaking load and of the maximum expansion before breaking. By testing a number of rings of different material and of different design and proportions under these conditions considerable improvement has been made in the design of the friction clutches.

COMBINATION RUBBER AND STEEL VALVE.

THE use of a special process by which rubber is securely and lastingly attached to steel enables the makers of the Rub-Steel valve to produce a valve which resists warping and twisting under high pressures, and possesses the desirable seating qualities of a rubber surface.



RUBBER AND STEEL VALVE.

The construction consists of a plate of high-grade steel placed in the centre of the valve with a tough rubber composition on each side and edge. Because of the rigidity of form thus obtained, the surface of the valve retains its true normal position, and is not forced through the grating by high pressure. Its reduced thickness gives greater efficiency to the pump, and when pumping hot water, a softer valve may be used, thus securing a better seat on worn or uneven grids.

These valves are manufactured exclusively by Voorhees Rubber Mfg. Co., Jersey City, in four different grades covering all ordinary conditions as well as extra high temperatures, and condenser service. Canadian Fairbanks-Morse are Dominion agents.

* * *

AUTOMATIC DISTRIBUTING VALVE FOR STEAM PUMPS

DESIGNED to meet all the requirements of a successful device for controlling the distribution of steam in pump cylinders, the Attwood Patent Operating Valve is applicable to both horizontal and vertical pumps without any change. An explanation of the working is given in the following illustrations:

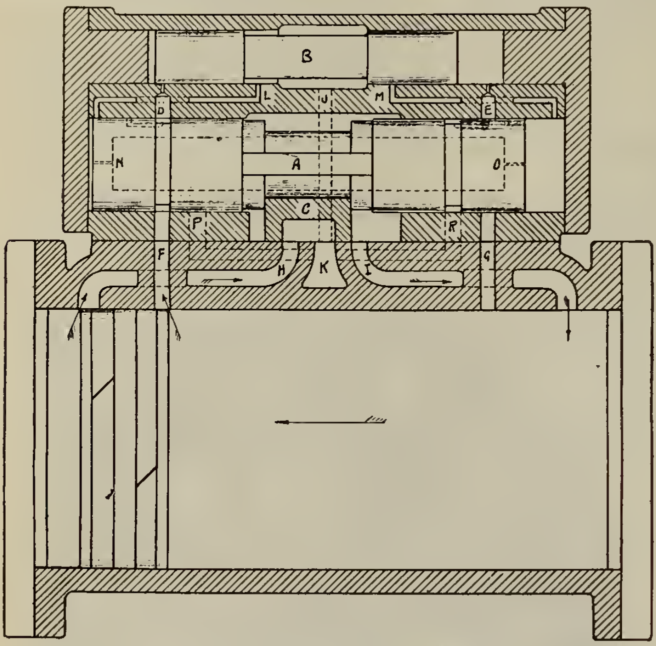


FIG. 1. SECTION OF CYLINDER ILLUSTRATING OPERATION OF DISTRIBUTING VALVE.

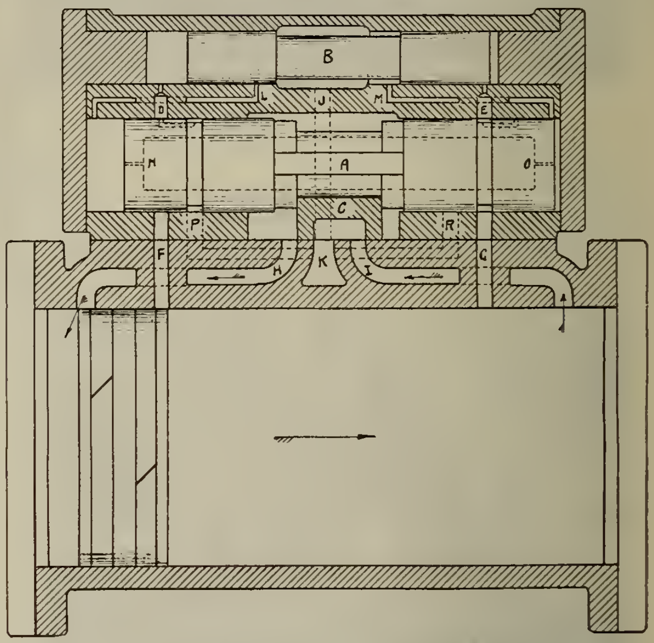


FIG. 2. SECTION OF CYLINDER ILLUSTRATING OPERATION OF DISTRIBUTING VALVE.

Figs. 1 and 2 show a sectional plan of steam cylinder and steam chest, exposing the two piston valves A and B, the slide valve C and also the steam piston. The piston valve A engages slide valve C, which opens ports H and I to live steam and to exhaust port K alternately in order to operate the steam piston.

Live steam is admitted to centre compartment of steam chest containing the piston valve A and slide valve C. When the valves are in position shown in Fig. 1, steam is entering cylinder by port I, and exhausting from cylinder by port H to main exhaust port K. Piston has completed its stroke from right to left by uncovering port F, and admitting steam by ports F and D on to end of piston valve B, which is now moved to the position shown in Fig. 2. Ports N and O admit live steam from the centre compartment of chest through the inside of piston valve A to the outer ends of same.

In Fig. 2 piston valve B has uncovered port M, and steam is exhausted from the right end of valve A through ports M and J to main exhaust port K, while port L is covered to the exhaust port J and steam accumulates at left end of valve A through port H and moves valve A from left to right, opening port H to live steam and port I to main exhaust, K. Ports D and P are now open to exhaust the valve B to main exhaust port K and when steam piston has completed its stroke from left to right the reverse operations are repeated through the ports E, R and G respectively. Valve A overruns ports L and M at each end of its stroke, thus preventing waste of steam.

Figs. 3 and 4 are front elevation and end views of the Attwood patent horizontal, inside packed, pot valve pump, which is designed for medium pressure boiler feeding, tank, vacuum, and general purposes. Fig. 5 is a cross section through one end of the steam cylinder showing the main steam port entering the lower side of the cylinder bore.

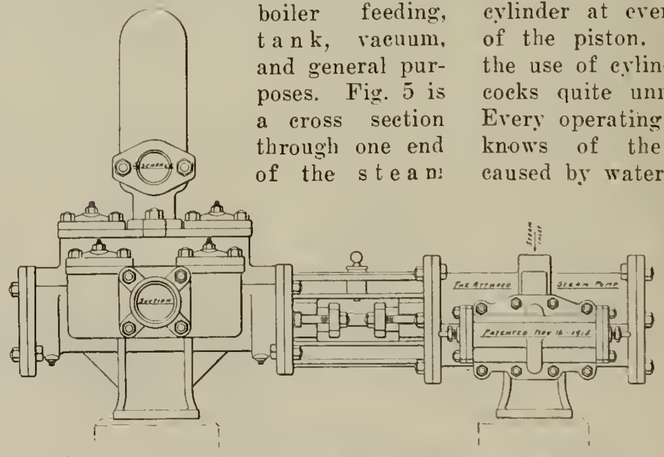


FIG. 3. ELEVATION OF INSIDE PACKED POT VALVE PUMP.

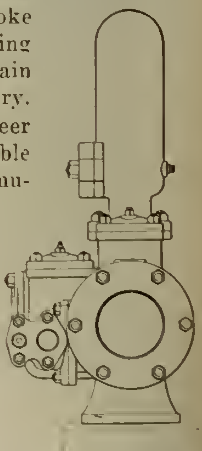


FIG. 4. END VIEW OF FIG. 3.

Fig. 6 is a cross section through centre of steam cylinder and steam chest, showing screw tappings for steam, exhaust and lubricator connections. Fig. 7 is the same type of pump as Fig. 3, but fitted with extra long stretcher and piston rod which is the usual practice when used for pumping tar and chemicals, to prevent the fluid being carried by the pump rod into the steam cylinder.

Figs. 8 and 9 are front and side views of vertical outside packed ram steam pump, especially designed for high pressure boiler feeding and also for mine sinking purposes. Engineering readers will at once notice a distinct advance in the right direction by placing the steam chest and cylinder ports of the Attwood pump on the side of the cylinder instead of on the top as in previous designs, thus enabling the steam ports to drain the cylinder at every stroke of the piston, rendering the use of cylinder drain cocks quite unnecessary. Every operating engineer knows of the trouble caused by water accumulating in a pump cylinder when the steam ports are located on top of the cylinder necessitating the drain cocks to be left slightly open all the time to prevent water hammer. This condition becomes still more aggravated in a vacuum pump operated by a governor when used on a steam heating system owing to the slow piston speed and occasional periods of rest. Condensation will accumulate in the steam line as well as in the steam cylinder.

Vacuum pumps on low pressures will frequently refuse to start off the governor under such conditions until the cylinder drain cocks are opened. Again pumps for mining purposes have long and tortuous steam lines which are not insulated and frequently have cold water dripping on them from the roof. Such conditions are the worst possible and produce the maximum amount of condensation and trouble for the engineer. The cylinder and valve becomes water-logged, lubrication is washed away, rod and joint packings are ruined and cylinder heads and pistons are frequently broken because the cushion is destroyed by the presence of water in the cylinder.

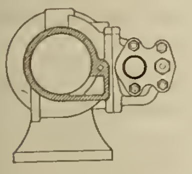


FIG. 5.

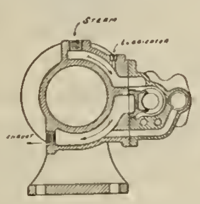


FIG. 6.

An examination of the drawings accompanying this article reveal two notable facts, viz.: 1st. The simplicity of the valve motion and its operation. 2nd. A complete automatic self-draining system accomplished by the disposition of steam chest, steam cylinder ports and pipe connections, as illustrated in Figs. 5 and 6.

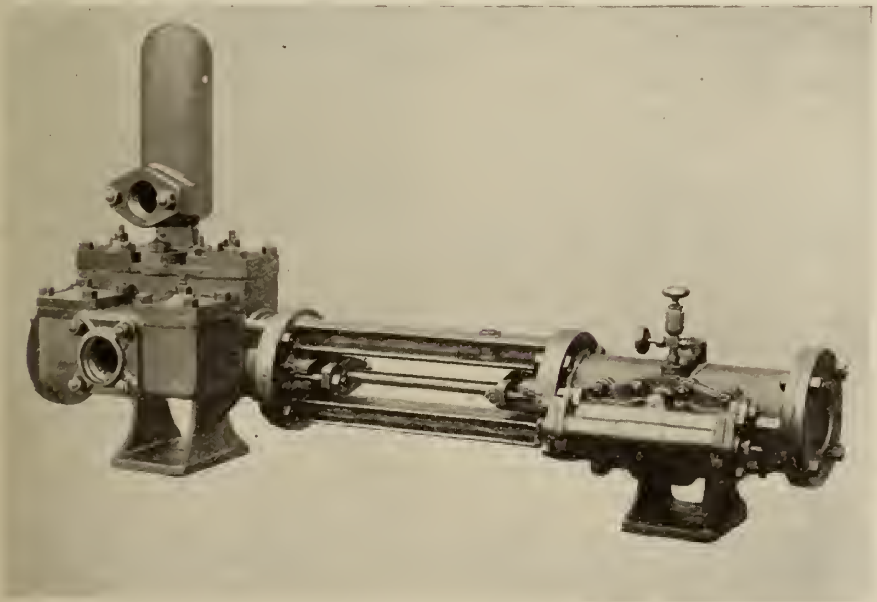


FIG. 7. HORIZONTAL, INSIDE PACKED, POT VALVE PUMP WITH EXTRA LONG STRETCHER AND PISTON ROD.

It is apparent that cylinder drain cocks are superflfluous because condensation through all the operations drains to the atmosphere by gravitation and the arrangements of steam ports permit the use of saturated steam without any risk to the cylinder head as already demonstrated by a series of daring experiments carried out under the worst conditions.

Figs. 8 and 9 show improved designs of a vertical outside packed ram pump which has the special feature of dispensing with one of the ram packing glands used on this type of pump, thus enabling an outside packed pump to occupy practically no more space than an inside packed pump of same length of stroke.

The saving in weight, friction, packing and space appeals to marine and stationary engineers alike, and the moving parts which are accessible without disturbing any pipe connections are a feature of convenience that will be appreciated by everyone experienced in the upkeep and repair of machinery.

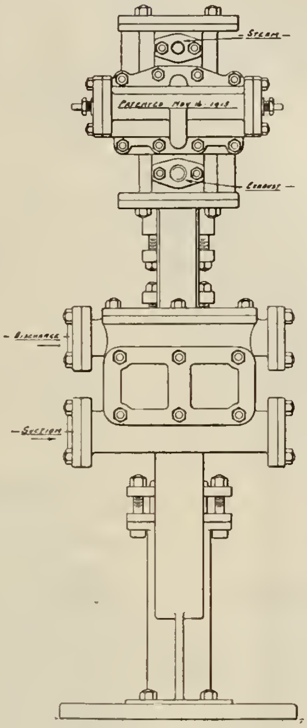


FIG. 8. FRONT ELEVATION OF OUTSIDE PACKED RAM PUMP.

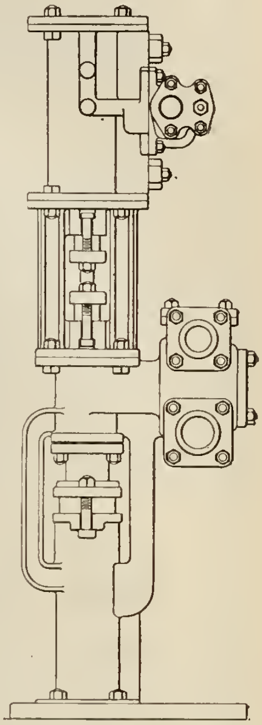


FIG. 9. SIDE VIEW OF FIG. 8.

⚙

ROPE DRIVE ADVANTAGES

I AM inclined to favor a rope drive in preference to a belt when the belt to be replaced is over 12 inches in width, says a writer in the Paper Trade Journal. Having had experience with both, he finds that the rope drive is much better than the belt. There are several advantages claimed by installing a rope drive.

1.—It is economical; the drive being cheaper to install than that by leather or other similar belting.

2.—The ease by which the power is transmitted to any distance or in any direction.

3.—There is less loss by slipping.

A single rope is carried round the pulley as many times as is necessary to produce the required tractive effort, while the necessary tension is obtained by passing the rope around a tension pulley weighted to give the desired strain.

The ropes used in rope transmission are of hemp, Manila, or cotton. Manila ropes are perhaps mostly employed.

The breaking strength of the rope varies from 7,000 to 12,000 pounds per square inch in cross section, and the average value may be taken as $7000D^2$ when D is the diameter of the rope in inches. The weight of ordinary Manila or cotton rope is about .3D pounds per foot of length. For continuous transmission, it has been determined by experiment, that the best results are obtained when the tension on the driving side of the rope is about 1/35 of the breaking strength. The ropes run in V-shaped grooves. The co-efficient of friction for grooves with sides at an angle of 45 degrees may be taken at from .25 to .33. The formula for finding the horse-power transmitted is as follows:

$$H = \frac{xD^2}{825} \times \frac{200 - v^2}{107.2}$$

H—Horse-power transmitted.

D—Diameter of rope in inches.
v—Velocity of rope in feet per second.

The greatest tractive effort is obtained at a speed of about 84 feet per second. For higher velocities, the centrifugal force becomes so great that the effort is decreased; therefore, a rope should not run faster than about 5,000 feet per minute, and it would perhaps be better to limit the velocity to 3,500 feet per minute.

Rope pulleys differ from belt pulleys only in their rims. The inclination of the sides of the grooves may vary from 30° to 60°. The more acute the angle, the greater the coefficient of friction and consequent wear on the rope. The diameter of a rope pulley should be at least 30 times the diameter of the rope. When possible, the lower side of the rope should be the driving side, for in that case the rope embraces a greater portion of the pulley.

Trade Gossip

Shipsaw, Que.—Price Bros. & Co., will install a 5,000 h. p. turbine and generator at their plant here .

Thorold, Ont. — The Toronto-Niagara Power Co., is building a transformer house at a cost of $100,000.

St. Catherines, Ont.—The McKinnon Dash & Hardware Co., will build an extension to their power plant.

Nelson, B.C. — The West Kootenay Power & Light Co., is installing an 8,000 h.p. unit in their No. 2 plant.

Osaquan, Ont.—The Indian Lake Lumber Co., will develop a water power here. F. F. Wilson is superintendent.

Samuel Grover Veary, late chief mechanical engineer Montreal Waterworks, died in Montreal on August 2, aged 75.

Bothwell, Ont. — Crotty & Elliott, are having plans prepared for an oil power plant to be erected at a cost of $5,000.

Porcupine, Ont.—The Northern Power Co., will install a 4000-h.p. water turbine and generator in its power plant at Wawaitin, Ont.

Quebec, Que.—The City Council have awarded a contract for batteries for the fire alarm telegraph system to Goulet & Belanger at $3,041.

The Boving Hydraulic & Engineering Co., Lindsay, Ont., have been awarded a contract for water turbines by the City of Sherbrooke, Que.

Quebec, Que.—Goulet & Belanger, of this city, have been awarded the contract for the Quebec Exhibition lighting system. Estimated cost, $11,000.

Hamilton, Ont.—The City Council, is having plans prepared for an addition to the waterworks pumping plant to cost $70,000. James Bain is the engineer.

James, Loudon & Hertzberg, Limited, have been incorporated at Toronto with a capital of $20,000 to carry on business as consulting engineers at Toronto.

Laurie & Lamb, Montreal, have received an order for a 500 h.p. Belliss & Moreom engine for the Belgo-Canadian Pulp & Paper Co., Shawinigan Falls, Que.

Iroquois, Ont.—The Village Council have awarded a contract to the Swedish General Electric Co., Toronto, for a 125 kw. generator with exciter and switchboard.

Toronto, Ont.—Witchall & Son. Toronto, has received the contract for the erection of an ice plant for the William Davies Co., Front Street East, to cost $50,000.

A. C. Towne has resigned his position with the Canadian Johns-Manville Co., Montreal, to take charge of the engineering department of the Electrical Equipment Co., Montreal .

Fredericton, N. B.—The C. P. R. will erect four concrete buildings at McAdam Junction to be used as a power house, coaling plant, storage building, and blacksmith shop.

The Canadian General Electric Co., Toronto, have been awarded a contract for a 5,000 k.v.a. turbine and generator, condenser and pumps, etc., by the Acadia Coal Co., Stellarton, N.S.

Ottawa, Ont.—J. Sutherland of this city has received the contract for the erection of a power plant on Slater Street for the Imperial Realty Co., Ottawa, to cost $30,000.

Richmond Hill, Ont.—The Village Council contemplate installing a waterworks system at a cost estimated at $30,000. James, Loudon and Hertzberg of Toronto are the engineers.

Prince Rupert, B.C.—The City Council have awarded a contract for pumping equipment to the Canadian Fairbanks-Morse Co., and for steel pipe to Campbell Gordon & Co., Vanvouver, B.C.

The Canadian Westinghouse Co., of Hamilton, Ont., have been awarded a contract by the Great Lakes Power Co., of Sault Ste. Marie, Ont., for the electrical equipment for their new power plant.

Renfrew, Ont. — M. J. O'Brien will proceed with his development scheme at Calabogie, where 5,000 h.p. can be had. A power plant will be erected there and a transmission line installed between that point and Renfrew.

Dunnville, Ont.—The Town Council will submit a by-law to the ratepayers for authority to borrow $53,000 for the purpose of installing Hydro-electric light and power, and to buy out the plant of the existing light company.

Arnprior, Ont.—The Galetta Electric Power & Milling Co. have awarded a contract for a turbine to the Boving Hydraulic & Engineering Co., Lindsay, Ont. A 400 kw. generator and additional switchboard equipment will be supplied by the Canadian Westinghouse Co., Hamilton, Ont.

Lethbridge, Alta. — The following tenders have been submitted for the proposed filtration plant: New York Continental Jewell Filtration Co., of New York, $92,000; Roberts Filter Manufacturing Co., Darby, Pa., $95,000; Western Canada Foundry & Supply Co., $111,857.

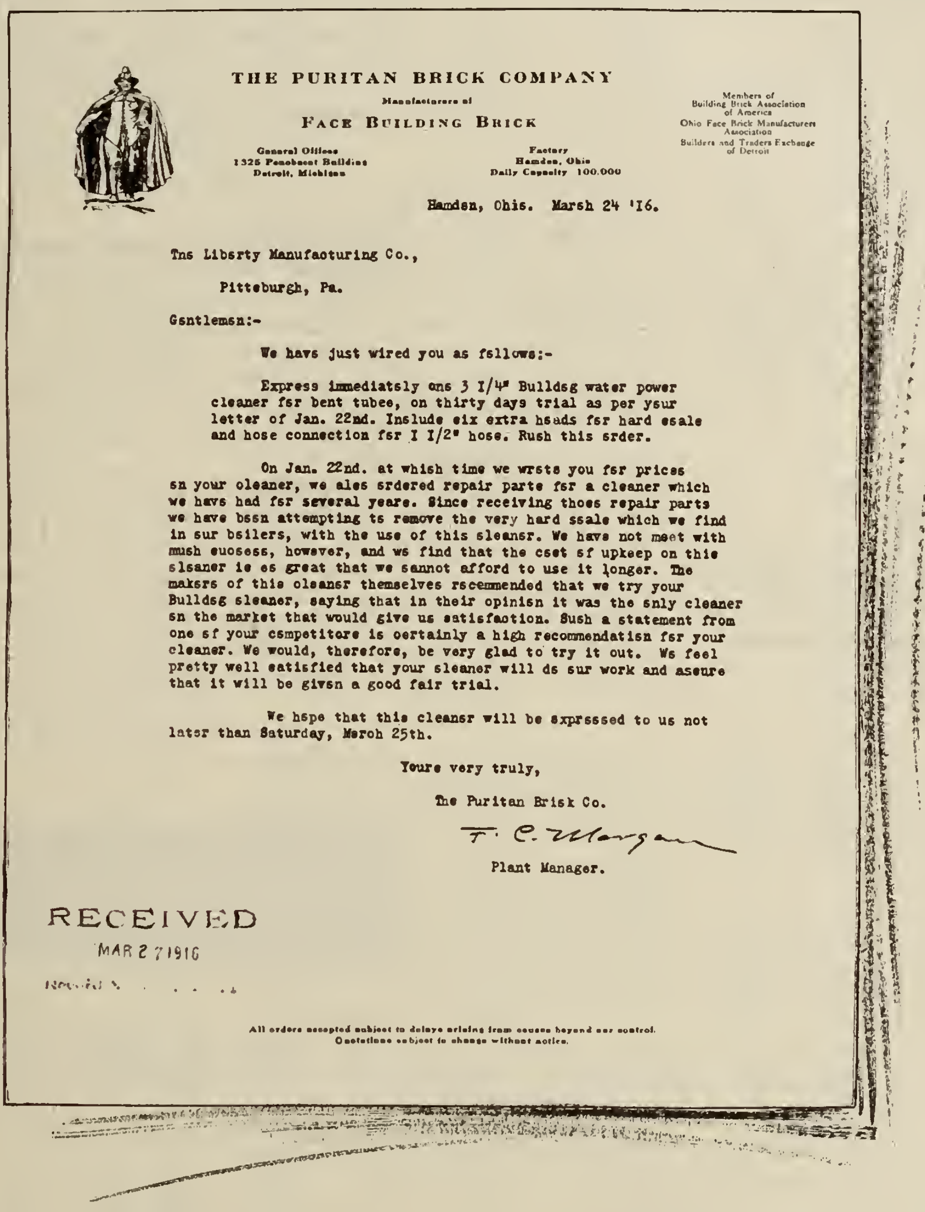
Captain F. Ross Newman has been invalided to England, suffering from trench fever. He has been at the front for some fifteen months, having gone there with a Toronto battalion which formed a unit of the 2nd Canadian Overseas Contingent. Previous to enlistment, Captain Newman was sales manager at Toronto for the Canadian Fairbanks-Morse Co.

Robert M. W. McLaren, secretary and managing director of D. K. McLaren, Ltd., belt manufacturers, Montreal died on August 20, aged 39. The deceased who was the youngest son of the late D. K. McLaren, founder of the concern, had been connected with the Company since its inception. He was well known in manufacturing circles both in Montreal and Western Ontario.

Toronto, Ont.—The William Davies Co. have had plans prepared for the erection of three buildings of flat slab concrete construction on Front Street east. The company will erect an abattoir and tank house, five and three storeys respectively, to cost $60,000; a cold storage building, six storeys, to cost $100,000, and stock pens, seven storeys, to cost $40,000. The total expenditure on the buildings will be $200,000.

John D. McEachren, a former well known manufacturer of Galt, Ont., died recently at Indianapolis, Ind. The late John D. McEachren was in his 81st year and was born in St. Croix, Quebec. He came to Galt from Harriston and after being engaged in various pursuits for several years, founded the McEachren Heating and Ventilating Co., now Sheldons, one of the largest plants manufacturing heating and ventilating machinery in Canada.

Read - This - Letter



THE PURITAN BRICK COMPANY
Manufacturers of
FACE BUILDING BRICK

General Offices
1325 Penobscot Building
Detroit, Michigan

Factory
Hamden, Ohio
Daily Capacity 100,000

Members of
Building Brick Association of America
Ohio Face Brick Manufacturers Association
Builders and Traders Exchange of Detroit

Hamden, Ohio. March 24 '16.

The Liberty Manufacturing Co.,
Pittsburgh, Pa.

Gentlemen:-

We have just wired you as follows:-

Express immediately one 3 1/4" Bulldog water power cleaner for bent tubes, on thirty days trial as per your letter of Jan. 22nd. Include six extra heads for hard scale and hose connection for 1 1/2" hose. Rush this order.

On Jan. 22nd. at which time we wrote you for prices on your cleaner, we also ordered repair parts for a cleaner which we have had for several years. Since receiving those repair parts we have been attempting to remove the very hard scale which we find in our boilers, with the use of this cleaner. We have not meet with much success, however, and we find that the cost of upkeep on this cleaner is so great that we cannot afford to use it longer. The makers of this cleaner themselves recommended that we try your Bulldog cleaner, saying that in their opinion it was the only cleaner on the market that would give us satisfaction. Such a statement from one of your competitors is certainly a high recommendation for your cleaner. We would, therefore, be very glad to try it out. We feel pretty well satisfied that your cleaner will do our work and assure that it will be given a good fair trial.

We hope that this cleaner will be expressed to us not later than Saturday, March 25th.

Yours very truly,

The Puritan Brick Co.

F. C. Morgan

Plant Manager.

RECEIVED
MAR 27 1916

All orders accepted subject to delays arising from causes beyond our control.
Quotations subject to change without notice.

Isn't that convincing? Can there be any question as to what boiler tube cleaner you should order?

It is after you have put a Liberty "Bulldog" Tube Cleaner at work on an unusually long and tough job, that you appreciate what REAL THING you have got in a Tube Cleaner. No scale proposition too hard for the "Bulldog."

Are you taking chances? Are you burning more fuel than necessary? Asking for a copy of Bulletin "H" is the first step toward better conditions. Will you send to-day?

Liberty Mfg. Company, 6904 Susquehanna Street, **Pittsburgh**

The International Engineering Co., Amherst, N.S., have sold two 600 h.p. water tube boilers to the Goodyear Tire & Rubber Co. for their plant at New Toronto, Ont.

The Storey Pump & Euipment Co. have secured a contract for two 6 in. two-stage Morris pumps with electric motors, from the corporation of Niagara-on-the-Lake. They have also supplied two similar pumps for water supply at Camp Borden. Among other orders of recent date are the following: Gutta Percha & Rubber Co., 16 x 4 x 10 in. Worthington duplex hydraulic pump; Goldie & McCulloch Co., 4 x 12 in. Deane duplex hydraulic plunger pump, for 1,500 lbs. pressure; several pumps for the New Imperial Oil building; five manganese steel-lined Morris centrifugal pumps for the Cobalt Reduction Co.; two three-stage, high duty motor-driven centrifugal pumps for Cordova Mines, Ltd., etc.

Catalogues

Portable Ohmeters.—Bulletin No. 300 recently issued by the Roller-Smith Co., New York, describes and illustrates the "Roller-Smith" portable direct reading slide wire ohmeter in two types, the telephone and galvanometer type.

Tool Chests made by the Union Tool Chest Works, Rochester, N. Y., Folder illustrating and describing many styles of tool chests for mechanics. Each style is illustrated and the dimensions are given for the various sizes.

The Chain Belt Co., Milwaukee, Wis., have issued a new folder No. 64 describing traveling water screens designed primarily to remove refuse and foreign material from water before it enters power plans or any industrial plant requiring large quantities of clean water. Illustrations are included showing installations.

T. W. Broadbent-Ltd., Huddersfield, England, have recently issued a leaflet No. 1 being a section of their catalogue dealing with "D" type generators for continuous current. The leaflet contains a specification covering the principal features in the design while a price list and shipping particulars are also included. The leaflet is illustrated.

The American Pulley Co., Philadelphia, Pa., have issued a booklet entitled "Belt Pulleys" being a report of tests for belt slip. The booklet contains a description of testing apparatus, methods and results of test with five data sheets giving full particulars of the tests. There are also included a number of curves showing the slip for various types of pulleys.

Graphite Sheet Lubricator. — The Strong, Carlisle & Hammond Co., Cleveland, Ohio, are distributing to the trade a series of leaflets describing the "Randall" graphite sheet lubricator for all kinds of machinery and wheel journals on cars and locomotives, etc. Directions are given for applying this lubricator and a number of illustrations show various types of bearings that have been equipped with it. A sample, together with literature, can be obtained on application by any dealer sufficiently interested.

Insuluminum. — Bulletin 118, just issued by the Diamond Power Specialty Co., Detroit, Mich., contains a number of photo-micrographs and describes the properties of this new product of the General Electric Co's. laboratories, which will withstand a continuous temperature of 1800 deg. Fahr., as compared to 1200 deg. Fahr., for iron and steel. Photographs and records of a series of comparative tests at high temperatures of insuluminum and iron pipes, made by a number of well-known companies, are included. The bulletin is "readable." It deals primarily with the interesting new metal, but the application of the material to the Diamond Mechanical Soot Blower System is described briefly on the concluding page.

Leather Belting.—A new catalogue just issued by the Graton & Knight Mfg. Co., Worcester, Mass., illustrates in every respect just what a publication of this nature should be, for, besides featuring all the products made by the company, a great deal of space is devoted to facts of general interest to those who purchase belting, lace leather, packings and other leather products. The belting section of the catalog is of unusual interest to buyers of belting, as it not only describes the characteristic qualities of each grade manufactured, but also explains clearly and conclusively why these grades are essential, their particular differences and capabilities. This section also embodies valuable mechanical rules, tables and formulas, to further assist the buyer to determine the proper grade, width and weight of belting required for any given drive.

A special section of the catalogue is devoted to leather packings, describing all the various kinds, grades and the advantages of each. An interesting and extensive line of leather goods are illustrated and described in the section devoted to same. A copy of this catalogue will be sent upon request to interested readers.

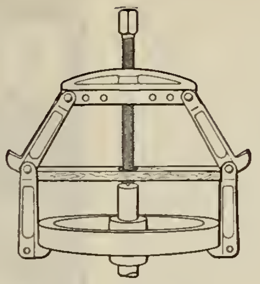
Belt Pulleys by Charles A. Brinley. A reprint of a paper recently read before the Engineer's Club of Philadelphia and issued by the American Pulley Co., Philadelphia, Pa. The intention of the paper was to draw the attention of engineers to the question of pulleys for the transmission of power by belts, and to point out that there is more in the selection of pulleys of a proper type than has been commonly supposed. The conclusions were arrived at by means of a number of tests, particulars and results being given accompanied by charts showing the respective merits of various types of pulleys. A list of data sheets is included to which references are made in the text, and this list can be obtained along with the reprint upon application to the American Pulley Co.

Bucket Conveyors. — The C. W. Hunt Co. Inc. West New Brighton, N. Y., have issued a catalogue No. 15-4 describing the "Hunt" noiseless pivoted bucket conveyor for handling coal, ashes, coke, phosphate rock, cement, clinker, etc. The catalogue has been issued with the object of suggesting to those operating or designing a power house the advantages and obvious savings possible with a properly arranged coal and ashes handling plant. The catalogue contains data valuable to an engineer in laying out a boiler house and a number of cuts showing different arrangements of the conveyors for various purposes. Several pages are devoted to reproductions of drawings showing conveyor details with dimensions. Other illustrations show driving mechanisms and valves etc .

"The Logic of the Dean," is the title of an attractive new 20-page booklet just issued by The William B. Pierce Co., Buffalo, N. Y., illustrating and describing their well-known "Dean" boiler tube cleaner. "The Logic of the Dean" is intended primarily for the management of the plant, although it contains a wealth of information of unusual value to the chief engineer or any of his assistants. The booklet, besides describing and illustrating the operation of the "Dean" cleaner, discusses the scale problem in detail. Some of the subject headings are: The Formation of Scale Cannot Be Prevented, The Relation of Scale to Fuel Consumption, How Shall Scale Be Removed, Some Things That Compounds Will and Will Not Do. Copies may be obtained on application by interested reader.

The Vulcan Soot Cleaner Co., Du Bois, Pa., have recently published an attractive book dealing with the "Vulcan" soot cleaner as applied to boilers, superheaters, economizers, garbage destructor boilers, waste heat boilers and similar apparatus. The book is arranged in seven sections. Section 1.—"What Soot Really Is" points out the predominance of ash in most soot, and what

CRANE'S New Model Patent Wheel Puller



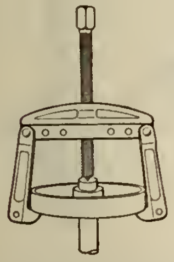
Work of Large Diameter (a piece of wood being used as a spreader)

For Removing Transmission and Cam Shaft Gears, Auto Wheels, Fly-Wheels, Sprockets, Collars, Couplings, Propellers, Universal Joints—For Straightening Shaft, Bending Pipe, Etc.

The screw has a flat end with inserted tempered tool steel point, that will not spread cutters. Makes its own centre on work that has none. The strain is taken on the flat end of the screw. Grease to keep from cutting. The screws are made of high carbon steel and case-hardened all over. All pullers are furnished with two sets of the new combination hook extension arms.

The Pipe-Bending Attachment consists of a pair of arms and forked end for the screw.

Write for full particulars.



Removing Work Near End of Shaft

The Crane Puller Co.

54 Lake Street

ARLINGTON, MASS., U. S. A.

Canadian Distributors: Canadian Fairbanks-Morse Co., Montreal, Toronto, Vancouver, Winnipeg, St. John, Calgary; John Millen & Son, Montreal, Toronto, Winnipeg, Vancouver.

ECONOMY

renewable cartridge

FUSES

are made in Canada

and sanctioned for use by the Canadian Fire Underwriters' Association. Here and in the States, millions of Economy Fuses protect lives and property at an annual *saving over old-style methods of eighty per cent. and more.*

Your request for Catalog 24 and free samples of the desired types and capacities will bring prompt response.

ECONOMY FUSE & MFG. CO. OF CANADA, LIMITED

UNITY BUILDING - MONTREAL

Manufacturers in Canada of "S. & C." High Potential Fuses,—to 150,000 Volts.

Sturtevant

(REG. CAN. PAT. OFF.)

Engines Can Be Packed Hot

If the piston rod stuffing-box of the Sturtevant Engine needs repacking, the engineer can do it immediately after stopping the engine—and without any danger of burning his hands. There is a long distance-piece which provides ready access and allows plenty of room for the hands.

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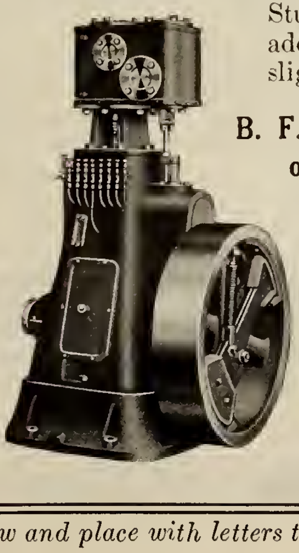

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happens if this is allowed to accumulate, not only as to reduction in efficiency, but by reason of the fusing and hardening of the deposit. Section 2.—"Why Clean Heating Surface Pays" gives the results of a large number of tests and investigations on the effect of soot deposit on efficiency of heating surface in boilers, superheaters and economizers, etc. Section 3.—"How Soot Cleaning Can Be Accomplished." Discusses the fundamental requirements of soot cleaning and what can be accomplished with hand-blowing. This is followed by a discussion of mechanical soot cleaning, which includes the principles of design of steam nozzles and their location in the boiler. Section 4.—Takes up the design of the "Vulcan" soot cleaner as applied to different types of water tube boilers. Section 5.—Is devoted to the "Vulcan" soot cleaner as applied to different types of fire-tube boilers. Section 6.—Is devoted to the application of "Vulcan" soot cleaners to economizers illustrating the design for both the straight and staggered tube types of economizer. Section 7.—"Details of Construction of the Vulcan Soot Cleaner," discusses the design of nozzles, anti-corrosion air relief valves and automatic tell-tale drain valves. The illustrations are unusually good and show the application of the "Vulcan" soot cleaner to various types of boilers etc. The frontispiece consists of a four-color reproduction of actual specimens of soot from different boilers and with different fuels.

Book Reviews

"**Water-Works and Sewerage Systems of Canada,**" by Leo G. Denis. This is a new edition which has just been issued by the Commission of Conservation. In the present report the various physical and financial data respecting water-works have been brought up to date and a new section on sewerage systems has been added. The book is a royal octavo volume, handsomely bound in cloth, contains 176 pages of text and is well illustrated with 25 halftones and 5 diagrams. In the year of Confederation there were only 7 waterworks plants in Canada; to-day there are 528. These have been built at a total cost of $123,725,633 and entail an annual maintenance charge of $4,558,589. The total daily consumption is 426,877,000 imperial gallons, which gives an average daily consumption per capita of 111 gallons, ranging from 50 gallons in Manitoba to 143 in New Brunswick. There are 206 plants supplied from springs or wells and 322 from lakes or streams. In 72 plants the water

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is filtered and in 21 plants it is treated with hypochlorite. The municipally owned plants number 396. As to rates, where specified, it is shown that flat rates are used in 209 cases, meters in 30, and both flat and meter in 141. There are 279 sewerage systems in Canada, having an aggregate mileage of 4,223 and which have been built at a total cost of $74,504,418. In only 75 municipalities is the sewage treated.

Mechanical Engineer's Hand-Book, by Lionel S. Marks, Editor-in-Chief, 1836 pages, (4½ in. x 7⅛ in.) limp leather binding. Published by the McGraw-Hill Book Co., Inc. N. Y., New York. Price $5.00 net. This is the first edition of a handbook intended to supply both the practising engineer and the student with a reference book which is authoritative in character and which covers the field of mechanical engineering in a comprehensive manner. The general arrangement of the handbook is based on "Hutte" and is the work of a number of specialists with Professor Marks as editor-in-chief. The various contributors are authorities on the subjects which they have contributed, a guarantee that the information is not only reliable but that it at the same time follows the latest practice. While the subject of "Fricton" and "Hydraulic Turbines" follow "Hutte" closely with the addition or substitution of American engineering data, the greater part of the book, particularly those portions which deal with engineering practice, are entirely new. The handbook is subdivided into fifteen sections well defined, dealing with major topics, and readily located by means of a thumb index. The first seven sections are to a large extent of a theoretical nature while the remaining eight are devoted to more practical subjects. The handbook contains a large number of well arranged mathematical tables of considerable value. The illustrations of which there are about one thousand, including charts and diagrams, have been carefully prepared and form a useful feature of this work. Engineers and students will find this a most valuable handbook, covering a wide range of subjects and dealing with each in a comprehensive manner. In addition to the thumb index there is one of important reference tables and a complete alphabetical index.

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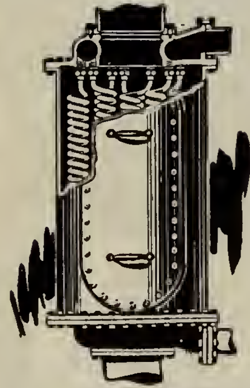

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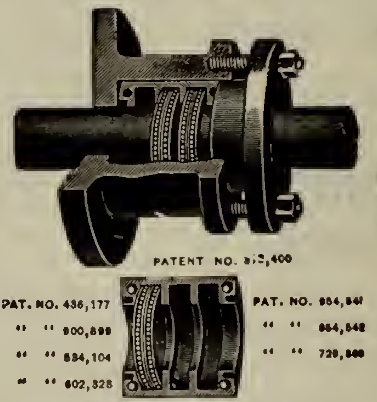

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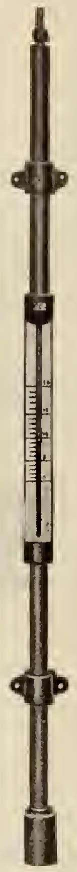

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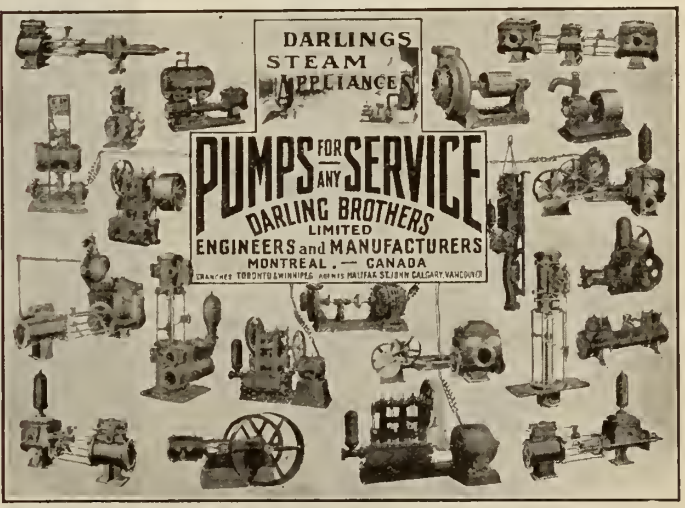

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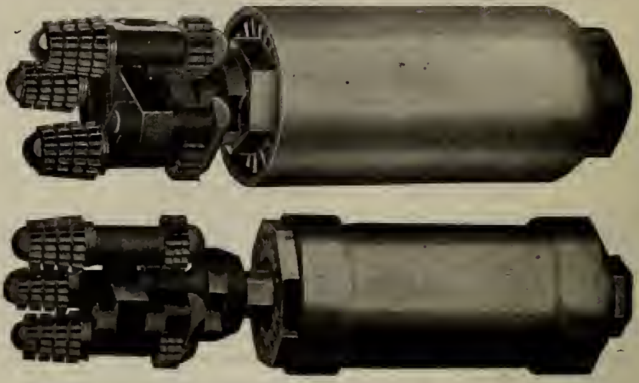

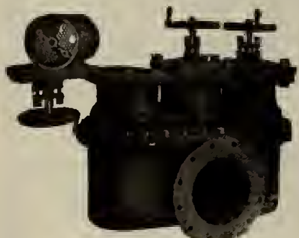

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Darling Bros., Montreal.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
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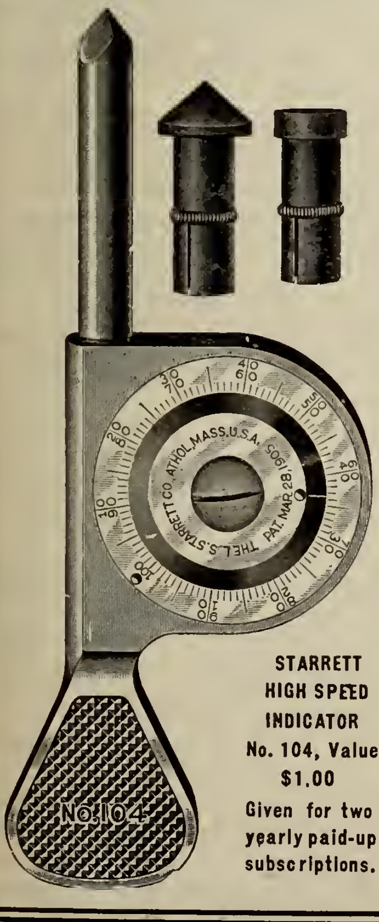

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Steel Mill Packing Co. 20
Stewart Heater Co. 9
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Y

York Mfg. Co. 32

STANDARD SUPER-HOT SPECIAL SOFT RED CONDENSER

Rub-Steel Valves

"THE VALVE WITH A BACKBONE"

WHAT IS IT? The Rub-Steel Valve is a valve made by a combination of rubber and steel.

THE CONSTRUCTION The construction consists of a plate of high grade steel placed in the center of the valve with a specially tough and lasting rubber composition on each side and edge, attached securely and lastingly to the metal by the Elchemco process, which chemically unites the rubber and steel.

THE PURPOSE The steel plate gives such strength to the valve that the highest pressure cannot warp, twist or in any way get it out of shape, while the rubber surfaces afford the proper seating qualities. **"Better than Metal Because of the Rubber—Better than Rubber Because of the Metal."**

WHAT IT ACCOMPLISHES It gives the valve a rigidity of form. It keeps the surface of the valve in its normal true position and insures a better seating quality. It prevents the high pressure from forcing the valve through the grating. It prevents the rubber from breaking up and the pieces causing trouble. It holds the surface of the valve in shape, so that when one side becomes worn the valve can be reversed without dressing. It is thinner and therefore gives greater efficiency to the pump. It permits the use of a softer valve for hot water, thus securing a better seat on worn or uneven "grids." It ensures an even distribution of the pressure, preventing "dishing" and the consequent cutting of the valve.

WHY YOU WANT IT **Because** its ultimate cost is less than that of ordinary type valves. **Because** it will last longer than other valves. **Because** it saves time and annoyance of replacement. **Because** its construction at once appeals to you as practical and sensible.

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The Canadian Fairbanks-Morse Co., Limited

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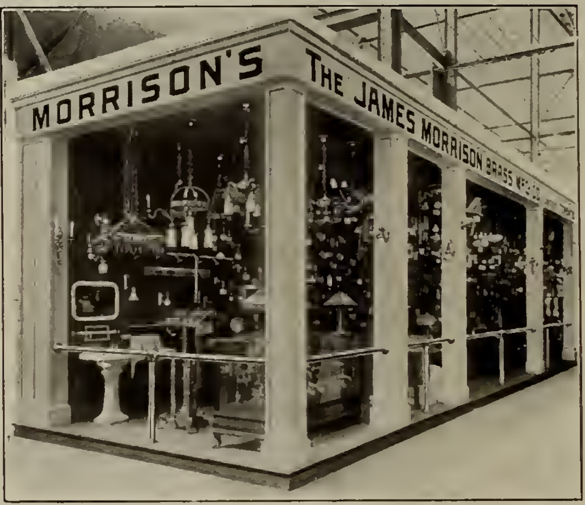

you will have a splendid opportunity of inspecting a full display of our high-class Brass and Iron Goods.

There will be all grades of specialties there — Steam, Electrical, Mechanical, Hydraulic, in Brass, Bronze and Iron for use afloat or ashore, in factories, power plants, offices and homes.

Our exhibit, always one of the most important, will be more interesting than ever this year. Morrison's Automatic Cellar Drainer, Stack Gas Water Heater, and Allman Automatic Gas Water Heater may be seen in operation together with the most modern types of steam goods and specialties.

James Morrison Brass Mfg. Co., Ltd.
93-97 Adelaide Street West - - - Toronto, Canada

ANNUAL EQUIPMENT AND SUPPLY DIRECTORY NUMBER

THE POWER HOUSE

VOL. IX. ◆ PUBLICATION OFFICE, TORONTO, SEPTEMBER, 1916 ◆ No. 9

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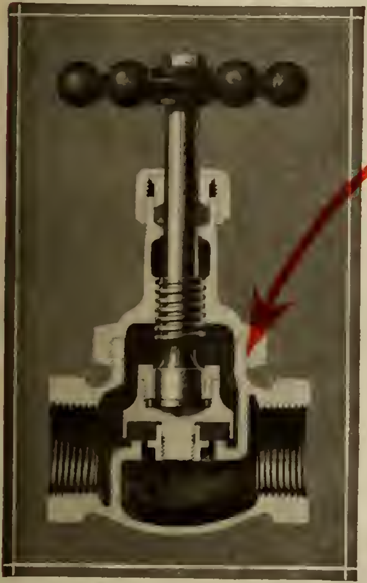
TRADE
PENBERTHY
MARK

ALL QUALITY BRASS VALVES

COMPODISK
with the Composition Disc

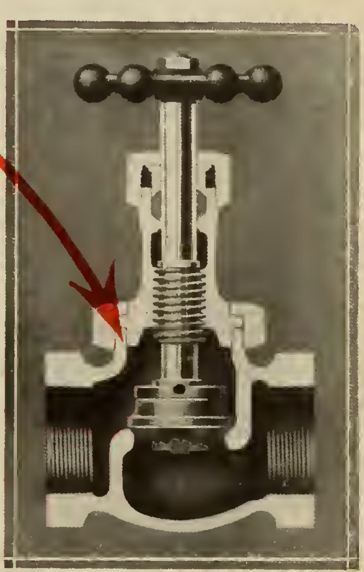
REGRINDING
with the Metal Disc



APPROVED FOR 175 LBS. PRESSURE

ALL PENBERTHY VALVES HAVE THE EXTERNAL THREAD CONSTRUCTION

STRONG
Where others are weak



APPROVED FOR 200 LBS. PRESSURE

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Outside Thread Construction

Why These Valves Are Superior

1. The connection is non-corrosive because the threads (see cut) are on the outside, away from the action of steam and water, making it impossible for them to become lined up and corroded.
2. The connection is stronger, more rigid and always steam-tight.
3. Prevents straining or spreading of bonnet end of valve which causes a loose fitting and unsafe bonnet—Safety First.
4. It prevents stripping of threads.
5. It permits easy accessibility to the valve at any time without injury to any part of it.
6. It is the only correct mechanical method of fastening bonnet to body of valve.
7. The external thread construction permits of a more compact shaped valve, consequently a stronger one.

For Sale by Leading Jobbers Everywhere

Manufactured by
PENBERTHY INJECTOR CO., LIMITED, WINDSOR ONTARIO

THE MACLEAN PUBLISHING COMPANY, LIMITED
Montreal Winnipeg New York Toronto Chicago Boston Cleveland London, Eng.

RAINBOW SHEET PACKING

Has been imitated but never equalled. It will give longer and better service than any red sheet made. Recommended for steam, air, hot and cold water.

There is a PEERLESS PACKING for every condition

HONEST JOHN for hydraulic work.

RAINBESTO for high pressure steam.

PEERLESS PISTON packing for steam up to 150 lbs. pressure.

WIZARD GLOBE and Angle Valve Packing—and 100 other styles, each for a particular purpose.

Put your packing troubles up to PEERLESS and watch us make good.

PEERLESS RUBBER MFG. CO.

31 WARREN STREET, NEW YORK

All Peerless Packings are carried in stock by CANADIAN ASBESTOS CO., MONTREAL.
Write or wire them for quick deliveries.

For Modern Boiler Room Piping

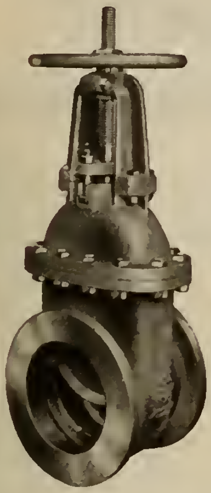

Fig. 404.

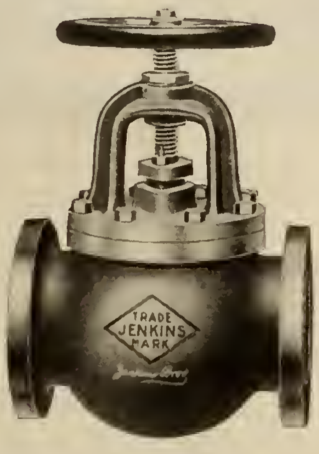

Fig. 142.

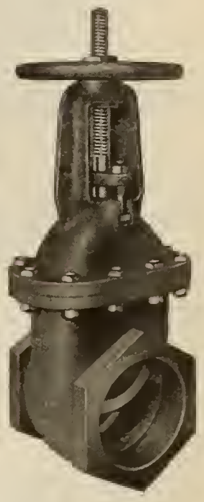

Fig. 403.

Jenkins Bros. Valves

They comprise a complete line for every class of service. Our engineers are always pleased to co-operate with prospective purchasers in the selection of the proper types and sizes of valves required.

Jenkins Bros. Automatic Equalizing Stop and Check Valves safeguard the boiler plant against disaster following the sudden reversal of high-pressure steam flow into a damaged boiler.

Jenkins Bros. Gate Valves made with brass, iron or cast steel bodies, in extra heavy, medium and standard patterns, screwed or flanged. Unexcelled in tightness and durability.

Jenkins Bros. Globe, Angle, Cross and Check Valves either brass, iron body, or cast steel, screwed or flanged, meet the hardest service conditions.

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Jenkins Bros. Boiler Specialties include Ball Gauge Cocks, Graber Indicating Automatic Water Gauges, Injectors, Reducing Valves, Pump Governors, Jenkins '96, and Jenarco Packings and Mechanical Rubber Goods. **Write for the No. 8 Jenkins Bros. Catalogue describing the complete line.**

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Jenkins Bros

Jenkins Bros. LIMITED

TRADE JENKINS MARK
Jenkins Bros

103 ST. REMI ST. MONTREAL

If any advertisement interests you, tear it out now and place with letters to be answered.

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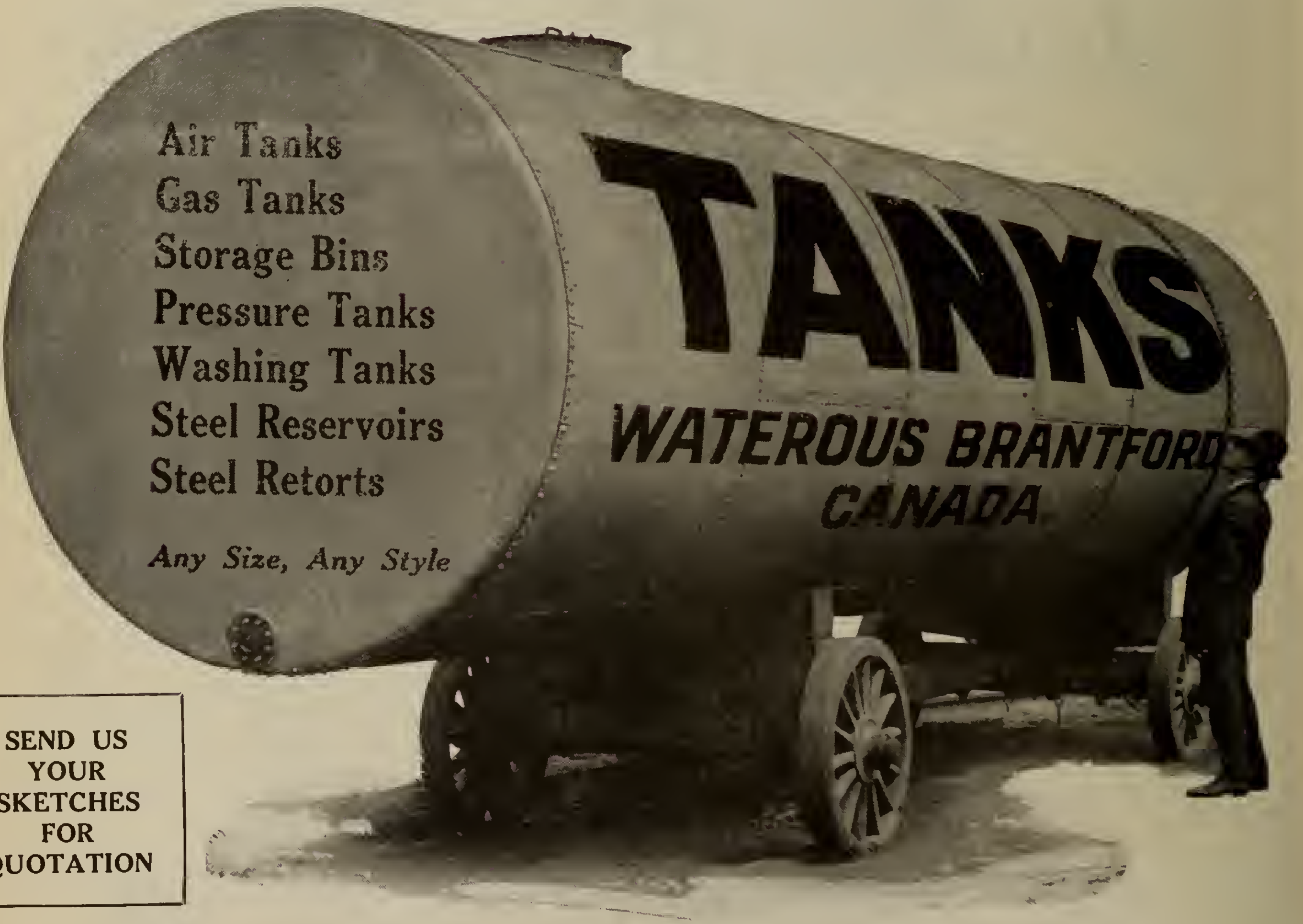
Steel Plate Work

Waterous Steel Plate Work is built to give service, first, last and all the time. ***The wear is there***—it's put in in the building. We use the best materials only, build right up to specifications, and turn out this work in a modern shop by modern methods.

Are you finding it hard to get this sort of work?

Put your next job up to us. We'll turn it out as it should be—it won't cost you more than the other kind, and will last twice as long.



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The Waterous Engine Works Co., Ltd., Brantford, Canada

WATEROUS

Return Tubular Boilers

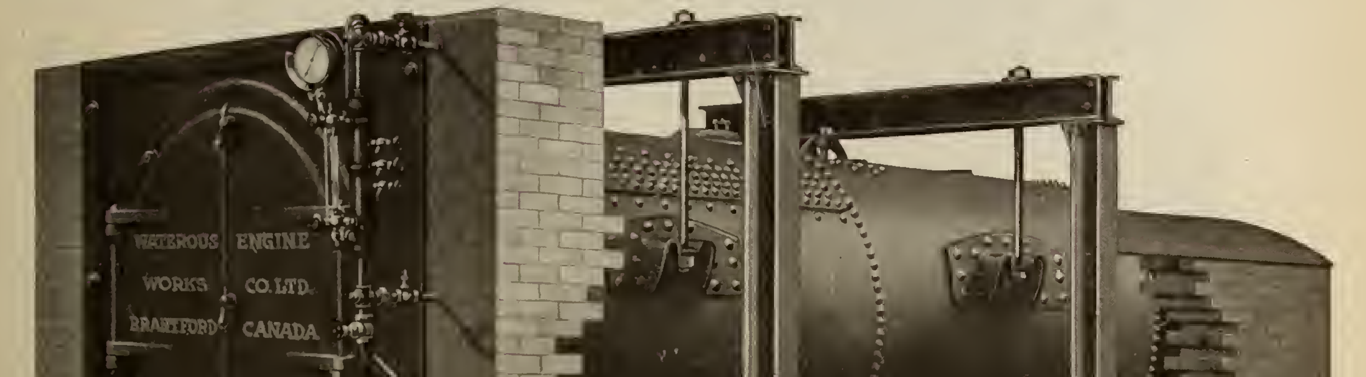
If you appreciate economy, convenience and safety in your Boiler room, let the next boiler you buy be "Waterous built."

Clean-cut construction, honest materials and honest workmanship distinguish them—they are better than required by law.

All sizes and styles from 20 H.P. to 165 H.P.

We specialize in the construction of boiler settings—built in brick or all-steel—to burn the fuel you use to the best advantage.

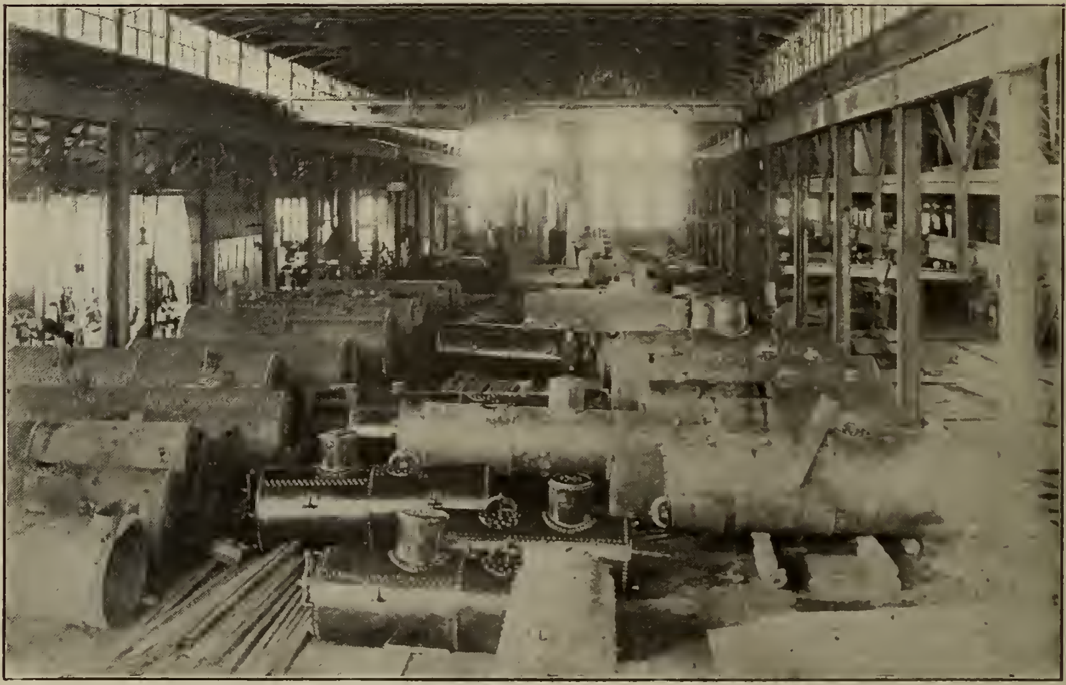
Write us when you're in the market.



The Waterous Engine Works Co., Ltd., Brantford, Canada

Jenckes Boilers

Vertical Tubular
Horizontal Tubular
Locomotive Types
Heating Boilers



Our Boiler Department with Boilers in Various Stages of Construction

Built of highest grade materials by modern methods.

Built for Service and

Built in accordance with any Provincial Boiler Code.

Quotations and estimates furnished with pleasure.

The Jenckes Machine Co., Limited

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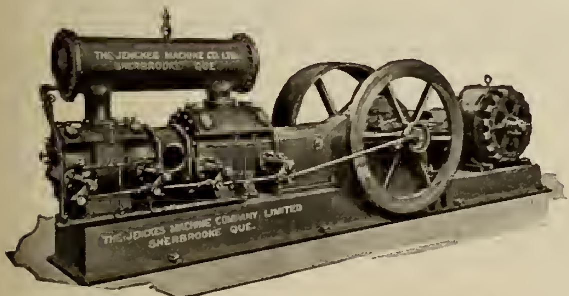
Works: SHERBROOKE, QUE., and ST. CATHARINES, ONT.

JENCKES
AIR COMPRESSORS



Class CBC-2. Straight Line, Two-stage, Motor-Driven.

THE design and construction throughout are of the highest class, the machines being built to successfully stand severe and continuous service.

We also build this type without motor, and with disc instead of Corliss Inlet Valves.

We Manufacture

a full line of Air Compressing Machinery, including all the regular types, single and multi-stage, belt, steam or electric driven, up to and including Cross Compound Corliss steam-driven machines, for large installations.

AIR RECEIVERS
HOISTING AND WINDING ENGINES
BOILERS OF ALL KINDS
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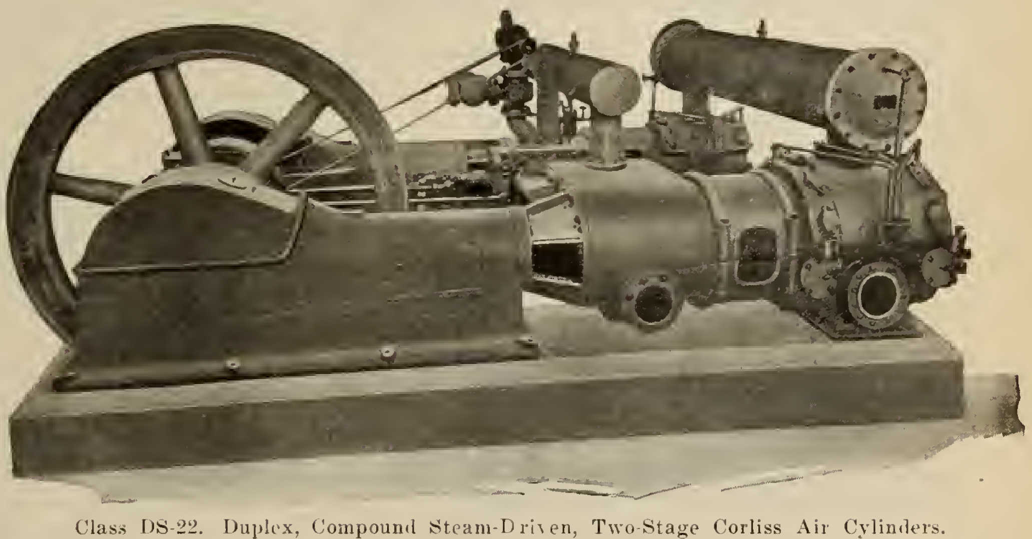
TANK PLATE AND
STRUCTURAL WORK OF ALL KINDS.

Requests for catalogs, estimates and information will be promptly honored.

THIS type of compressor is built in all sizes, varying from 500 cu. ft. displacement upward. The design combines close scientific study and a wide, practical experience in building, operating and observing air compressors under varying conditions.

We invite enquiries and will gladly send full specification and data of any machine.



Class DS-22. Duplex, Compound Steam-Driven, Two-Stage Corliss Air Cylinders.

The Jenckes Machine Company, Limited

Sherbrooke, Montreal, St. Catharines, Toronto, Cobalt, South Porcupine, Vancouver

Works: SHERBROOKE, QUE. ST. CATHARINES, ONT.

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WE have had many years' experience solving difficult power plant questions, of all kinds and conditions, and the benefit of this experience is yours in dealing with us. If your conditions are not suitable for equipment supplied by us, we do not hesitate to advise what we think will overcome your difficulties.

ON this, and the opposite page, a few of our lines are shown. In our opinion, after long experience, with many tests and trials, they are the best, will stand up the longest, and give the most efficient service, of any that are made on the continent.

H. L. Peiler & Co.
311 Kent Building, Toronto, Ont.
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We solicit your enquiries.

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Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

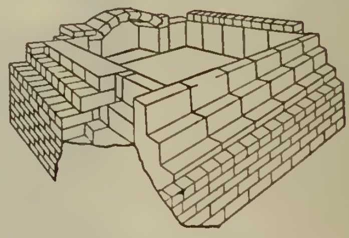
Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.
CANADIAN AGENTS
H. L. PEILER & CO., MONTREAL and TORONTO

Any Handy Man Can Renew These Blocks Without
Disturbing the Other Brickwork

Think what that means in time and labor-saving, in your own plant.



Gates Boiler Furnace
Patent Applied For

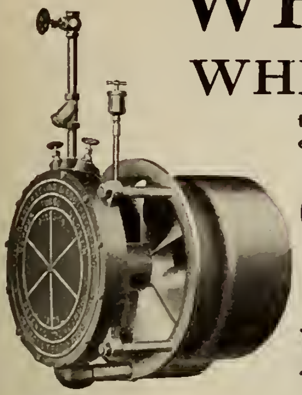
This furnace will last three times as long as ordinary good fire-brick. The blocks are interlocking, and can be renewed at any time, very easily. The arch is also interlocked.

Write us for particulars and names of satisfied users. You will serve your own purpose by learning about this furnace even though you are not ready to instal it.

John W. Gates
382 St. James St. MONTREAL P.Q.

WHY are you burning such expensive coal?

WHEN you can carry full steam pressure with the cheapest coal available by equipping your boilers with a



COPPUS TURBO BLOWER

The blower will pay for itself in a short while. As much as 60% saving has been obtained by its use, and 25% saving is very common. Furthermore, you do not need to worry about your poor draft, lack of boiler capacity and inability to keep up steam pressure. All these troubles are remedied by the Coppus.
Cut out this Ad., put your name and address on the margin, and mail to us. Without further trouble you will get all the particulars.

500,000 H.P.

in boilers equipped with Coppus Turbo Blowers in four years.
The Coppus has replaced a great many other blowers, but no other blower has ever replaced a Coppus.

Coppus Engineering & Equipment Company
167 Union Street, Worcester, Mass.
Canadian Sales Agents:
H. L. Peiler & Co., Montreal and Toronto.

Bundy Steam Traps

When you get heat into water, keep it there! Keep it there and hold it there as long as possible, no matter where the water goes. This is the idea which the makers of the

BUNDY STEAM TRAPS

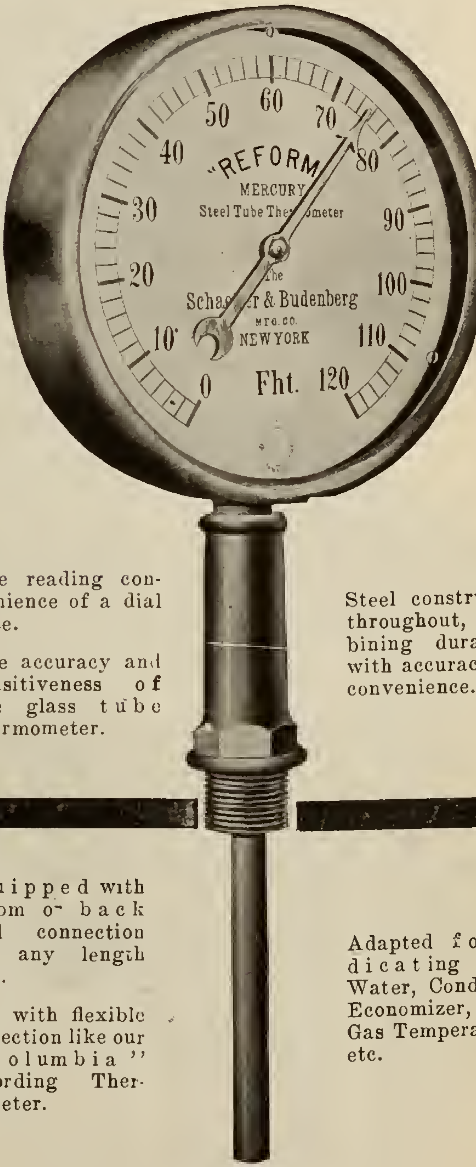
have been driving home to power plant men for years.

BUNDY STEAM TRAPS
combine Power, Simplicity and Efficiency

Nashua Machine Company
Manufacturers
Nashua - New Hampshire

H. L. PEILER & CO.
380 St. James Street - - Montreal
Are Our Agents in Canada

"REFORM" Mercury Actuated Dial Thermometer



The reading convenience of a dial face.

The accuracy and sensitiveness of the glass tube thermometer.

Steel construction throughout, combining durability with accuracy and convenience.

Equipped with bottom or back rigid connection and any length stem.

Also with flexible connection like our "Columbia" Recording Thermometer.

Adapted for indicating Feed Water, Condenser, Economizer, Flue Gas Temperatures, etc.

Ask for Pamphlet
W-101

THE Schaeffer & Budenberg MFG. CO.

Makers of "Columbia" Recorders, "Crescent" Thermometers, S & B Gauges, Tachometers, Counters, Calorimeters, Indicators, etc.

Berry and South 5th Streets, Brooklyn, N. Y.
Also Chicago, Philadelphia, Pittsburgh.

Murphy Automatic Furnace

Murphy Automatic Smokeless Furnaces

Canadian Repeat Orders Since January 1st, 1916

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and Thirty-three Repeat Orders from American Users—one of which was **18th contract;** the 18 contracts cover **136 MURPHY FURNACES**

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MURPHY IRON WORKS, BUFFALO, N. Y.
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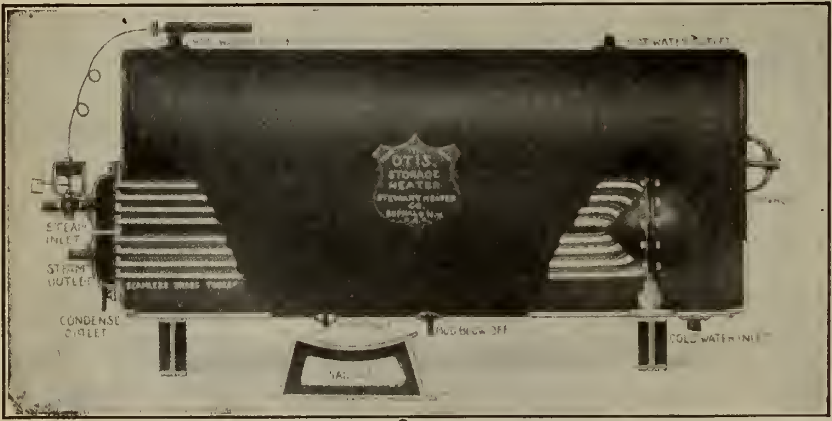

OTIS HORIZONTAL STORAGE HEATER

Laundries, Dairies, Hospitals and Hotels are a few of the institutions where the "OTIS" is necessary and economical, and you should consider this along with its other improved features. 1—Can be supplied with either exhaust or live steam. 2—Fitted with a closely adjusted regulator. 3—Tubes can be readily withdrawn from the body of the heater. 4—A double set of heating tubes, one for exhaust and one for live steam.

But write us or our agents for full particulars, please.

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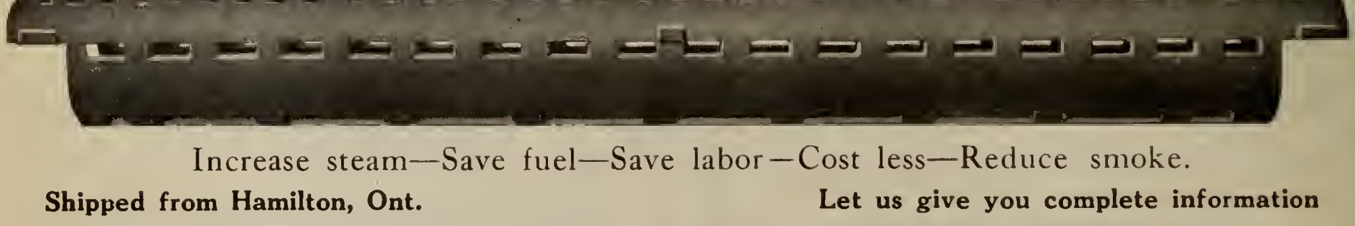
Canadian Agents:
Geo. W. Cole Company
838 Dundas Street, Toronto, Canada.

THOMAS ELLIPTIC GRATE BARS—SHAKING CIRCLE STATIONARY

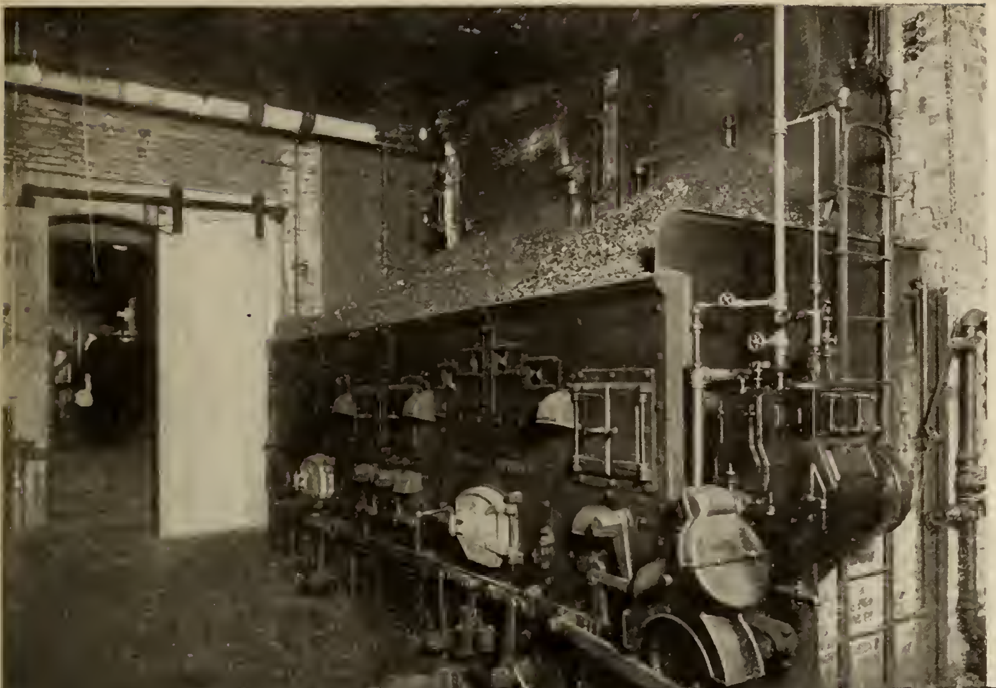


Increase steam—Save fuel—Save labor—Cost less—Reduce smoke.

Shipped from Hamilton, Ont. **Let us give you complete information**

FOR ALL PROBLEMS—**Steam—Grate Bar—Furnace—write THOMAS**

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.



In Use Two Years

Two in Use for Two Years

Installing Three More

When asked what he thought of Detroit stokers, the engineer at the plant of The Robertson Bros., Limited, said: "I think so much of the service received from the ones purchased two years ago that I am installing three more."

Installing Three More

DETROIT STOKERS

can be applied to all leading types of boilers of all sizes.

OPERATION

It is of the side feed, inclined grate type, with coal magazines on each side into which coal can be fed mechanically or by hand. As the coal leaves the magazine it becomes coked, and the volatile gases, which are driven off, become mixed with the heated air which enters through the openings directly over the coking coal, forming a combustible gas. The fuel travels slowly down the inclined grates, of which each alternate one is vibrating grate. The movement of the vibrating grates actuates the fuel bed toward the center, where combustion is completed. The clinker crusher, having a continuous motion, grinds the clinkers and deposits the refuse in the ash-pit below.

ECONOMY AND CAPACITY

Its flexibility for variable loads and its ability to increase boiler capacity with high efficiency is important. A saving in fuel cost of from ten to twenty per cent. is obtained, and in large plants there is an additional saving in labor.

The simple construction makes the operation easy in the hands of inexperienced labor often found in the boiler room.

DISTINGUISHING FEATURES

The Detroit Stoker is automatic in all its operations. It mechanically feeds and distributes the fuel and removes the ash and clinker automatically.
It has nearly twice the cooking surface of any other type, obtaining perfect combustion at a slower speed.
It operates with natural draft, without the use of fans or blowers, and requires less power for operation than any stoker using a mechanical or forced draft system.
The even distribution of air, under control, over the coking coal and under the fire-brick arch, insures complete combustion and a smokeless stack.
It can be operated by hand, avoiding the necessity of shutting down the boiler or plant in case of accident.
Send for Illustrated Descriptive Catalogue.

Detroit Stoker Company

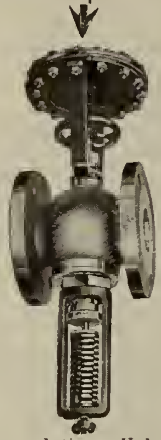
DETROIT, U. S. A.

A continuous graduated feed—

at all times load is on your boiler, is assured by the design of the

"S-C"

Feed Water Regulator



Regulating Valve Placed at Any Point, Any Position.

This method of designing, assembling and installing allows it to give you a continuous graduated feed and hold the water level within a close range.

Our feed water engineering service guarantees the success of every installation—

Write to-day for Bulletin 80 which gives the full details.

Generator or Actuating end of Regulator.

The "S-C" Regulator Company

Feed Water Regulation Engineers

Fostoria, Ohio, U.S.A.

All the Details of Safety Economy and Efficiency are embodied in

"Homestead" Quarter Turn Valves

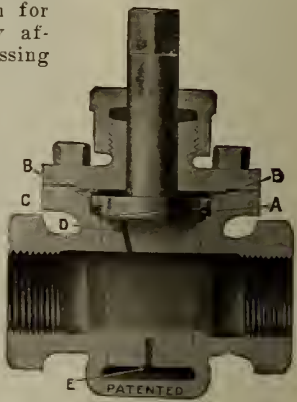
They open and close easily. The patented balancing parts insure this valve against sticking.

When the Homestead Valve is fully opened the two surfaces which are depended upon for tightness are in no way affected by the material passing through.

The plug cock provides a straight-way opening, which is desirable in all sorts of work, but is particularly important in high-pressure service. It is very useful when thick, heavy liquids are handled.

Among users are the largest mills, mines and railroad companies.

It will pay you to try them.



Homestead Valve Manufacturing Co.
PITTSBURGH, PA.
Works: Homestead, Pa.

Which do you want— Steam or Smoke?

"Bennis" Machine Stokers

don't make smoke—they abolish it, but for steam raising they are quite unequalled. A "Bennis" Stoker will reduce your coal bill by the efficient combustion of low quality fuels, will prolong the life of your boiler, and increase the effectiveness of the grate area. For fuller information write for catalogs.

EDWARD BENNIS & Co., LTD.
Little Hulton, Bolton, and 28 Victoria St., London, Eng.

¶ The King Edward is one of the most attractive hotels in Canada. Its managers are intelligent business men—they will have nothing but the *Best*, from coal bunkers to water-tank.

¶ Six years ago, they needed a boiler tube cleaner. They looked over the market and decided that the *Dean* operated on the *most logical* principle—*VIBRATION*. A trial was arranged. It quickly demonstrated the great superiority of the *Dean Cleaner* as a scale-remover from

Water-Tube Boilers

¶ To be sure, the *Dean* cost a bit more, but it took out every particle of scale and rendered truly efficient *Service*. That alone made it worth the slight extra cost.

¶ But, in addition to removing all the scale, it has been found the cheapest cleaner they ever used—*for six years it has done its work at a yearly upkeep cost of 68 cents.*

¶ When one stops to consider the high yearly repair charges for turbines (the excessive cost of cutter heads), together with the unending expense of "water treatments" and "metal treatments," is there any wonder the Engineer at this hotel swears *by*—and *not at—the Dean Cleaner?*

¶ For either water-tube or fire-tube boilers, any type, the *Dean Boiler Tube Cleaner* has a record of actual performance that makes it pre-eminently the real "service-giving" Cleaner of this century.

¶ You need the Dean, but probably don't know it. So, to make it easy for you to find out, we'll gladly ship you any size Dean you need for FREE TRIAL in one of your boilers. You pay nothing but express charges ONE WAY—we pay return charges if the tool is sent back.

¶ In any event, find out what good this Dean Cleaner will do you. Ask for Booklet No. 131.

The William B. Pierce Company
153 Ellicott St., Buffalo, N.Y.
201-2 Coristine Bldg.,
Montreal, Que.
Winnipeg Representative:
W. W. Hicks,
567 Banning St.

CO2 Recorder.

Your Aim

should be not alone to get after the leaks in your BOILER SETTINGS, but to keep after those leaks; and maintain Efficiency at MINIMUM costs in your Boiler Plant. Give your Engineer and Fireman adequate apparatus for these RESULTS. You will be more than repaid not only in DOLLARS saved, but in the interest shown by your Fireman.

PRECISION bulletins are yours for the asking. They include our ABC of Combustion, a valuable asset to your plant. It gives you many valuable points on proper firing and coal burning.

Illustrated here are the C02 Recorder for continuous record, and two types of Gauges. We can supply you with all types, all ranges, from the simplest U tube gauge, the Slant tube or Micrometer type, the accurate and sensitive PICO type, to the 3 in 1 type.

Precision Instrument Company
Engineers
Detroit Michigan

Recording Gauge.

Pico Differential Draft Gauge.

3 in 1 Gauge.

UNEQUALLED WORKMANSHIP
HIGHEST EFFICIENCY
COMPLETE SATISFACTION

ESCHER WYSS & CO.

WATER-WHEELS
GOVERNORS
TURBO-PUMPS
STEAM-TURBINES

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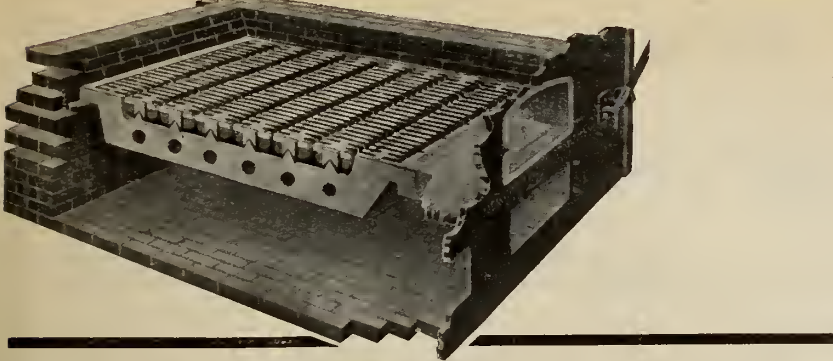
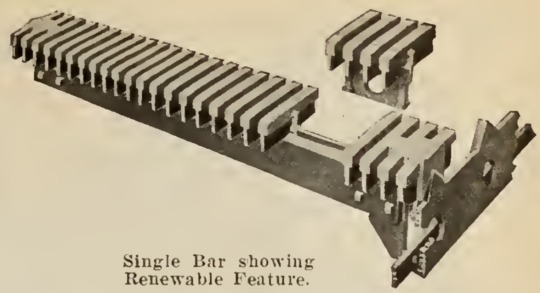
ESCHER WYSS & CO.
12 Coristine Bldg., Montreal





Single Bar showing Renewable Feature.

The McNaughton Sectional Rocking Grate Bar

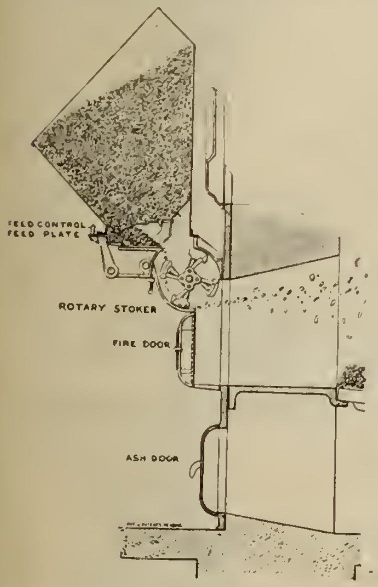
MADE IN CANADA

Advantages: The McNaughton Grate Bar is the simplest and most durable grate made. The frame castings are substantial and heavy; there is room for expansion between each section, and no part of the bar is ever under any heat strain. The McNaughton Grate Bar is adaptable to all types of boilers and fuels, and is in use in over one thousand power plants. Long life, high efficiency and low repairs are the chief features of the McNaughton Grate Bar. These grates are in operation in over 1200 power plants.

The Galt Sprinkler Stoker

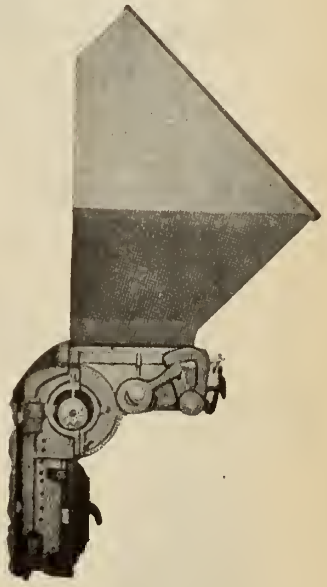
FOR SMOKELESS AND ECONOMICAL COMBUSTION AND UTILIZING LOW-GRADE FUELS. Over 600 Installations.
DISTINCTIVE STOKER DESIGN.

"Simplicity is the essence of Engineering."
Just compare hand-fired furnace methods with the **Galt Sprinkler Stoker.** This Stoker is a real mechanical Fireman.



Distributes Coal Evenly and Continuously Over Entire Grate Surface.

Free Access to Fire at all Times.



Stoker Replaces the Regular Fire-Door

In presenting this Stoker, we offer the product of years of development and test in commercial service under widely varying demands of load and operating conditions. It is used in all classes of installations, including power and heating boilers, annealing furnaces, reheating furnaces, etc., showing results equal to any stoker in the saving of fuel, labor and the elimination of smoke.

The Galt Stoker is a mechanical device attached to the boiler front, that continuously feeds and spreads the fuel, in any quantity desired, over the entire grate area, and accomplishes this without opening the fire-doors, and without smoke.

Lack of space prevents a full description of this machine being given, but a few of the features are:

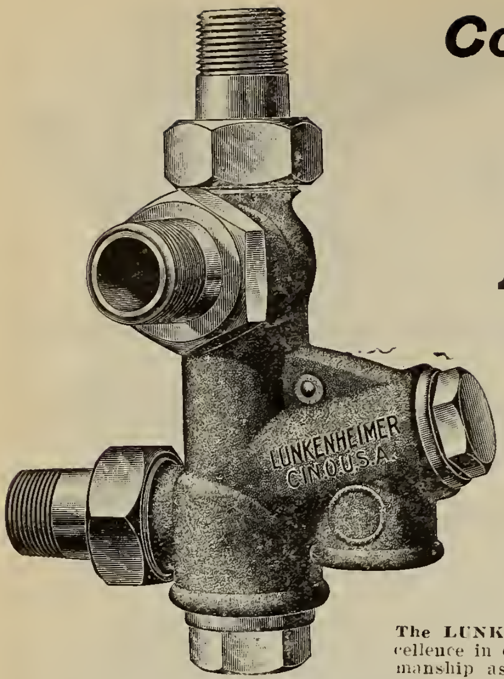
1—It automatically feeds and spreads the fuel evenly over the entire grate.
2—No change of the furnace setting is necessary to install it.
3—Any rate of feed can instantly be obtained by simply adjusting the hand wheel.
4—The mechanical power required to operate is only ¼ to 1-3 H.P. per stoker.
5—No special type of grate is necessary, although an efficient rocking grate is an advantage.
6—It is low in first cost, and repairs are practically nil.
7—All parts of the stoker are out of furnace—nothing to burn out.
8—It permits inexperienced help to equal the most expert fireman.
9—It has a self-contained fire-door that permits of hand-firing in case of emergency.
10—It increases the boiler efficiency and capacity without smoke.
11—It operates on natural draft and requires no fans or blowers. The stoker mechanism is driven by a small vertical adjustable speed steam engine or motor. It will smokelessly burn bituminous slack or run-of-mine coal. It will produce 170% Boiler rating, with natural draft with a fire 3" thick.
12—It will effect a positive saving in cost of fuel of 10% to 15% over good hand-firing.

All inquiries regarding Galt Sprinkler Stokers and McNaughton Grates will receive our prompt attention.

GALT FOUNDRY CO.
GALT, ONTARIO

Agents for Ottawa:
Campbell Steel and Iron Works,
Ottawa, Ont.

Agents for Quebec:
The R. E. Cleaton Co.,
Coristine Bldg., Montreal



Convincing evidence!

Impartial tests in actual service clearly show that the

LUNKENHEIMER
Automatic Injector

Excels in Efficiency:

(1) *It will deliver more water per pound of steam than any other.*
(2) *Its capacity is diminished in a lesser degree by long lifts and hot feed water than any other.*
(3) *It is absolutely automatic at all times.*
(4) *It will restart instantly after a temporary interruption of either the steam or water supply.*
(5) *The amount of water delivered can be graded over 50 per cent.*

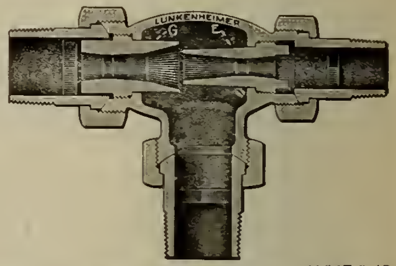
The correct design of the tubes, and the large areas through the body account for the excellent working of the Injector, and the special bronze composition used (made expressly for the purpose) insures long life to the machine. Its installation means efficient service, and lasting satisfaction to the user.

The LUNKENHEIMER EJECTOR embodies the same excellence in design and the high quality material and workmanship as the Injector. It is an efficient machine for raising water from pits or deep wells, filling or emptying tanks, etc. Made in eight sizes, with capacities from 250 to 11,000 gallons per hour.

Buy the best—They are the cheapest.—Your local dealer can furnish them; if not write us.

Write for Booklet No. 504

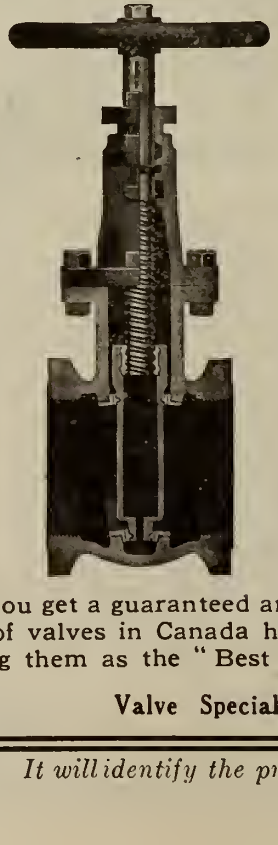
THE LUNKENHEIMER CO.
"QUALITY"
Largest Manufacturers of High-Grade Engineering Specialties in the World
New York Chicago CINCINNATI, O., U.S.A. Boston London



19307-S-43

KERR
("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists Walkerville, Ont.

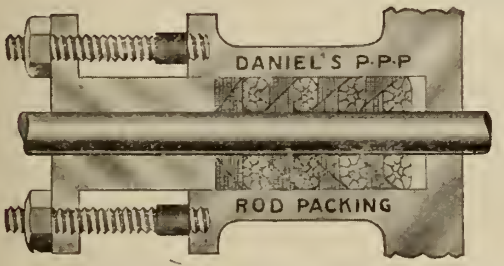
Look Out for "Sharks"

It is the part of wisdom to keep away from waters frequented by sharks. This "safety first" rule should also be applied against your engine-room being entered by "sharks" that try to induce you (because the "sharks" make bigger profits) to accept substitutes for standard, advertised goods.

The "just-as-good-as-P-P-P" "sharks" are unusually busy just now. But don't let them "bite" you. Remember, there is but ONE genuine—

DANIEL'S ROD PACKING **P.P.P.** **FOR STEAM, AIR, WATER, AMMONIA**

Reg. U S. Pat. Off.



The cut shows a new ring of P. P. P. (the top one) inserted to make up for wear on the wedges of the lower, older rings.

This illustration also shows (see bottom ring) how the cushion compensates for the wear of the wedges next to the rod, thereby retaining the remarkable efficiency of P. P. P.

Note—The packing is shown under pressure, and while the REGULAR style is used, the illustration applies to all styles of P. P. P.

Did you ever want to know

....the number of plies in different widths of belting?

....the sizes of steam hose? the plies?

....the standard thicknesses of sheet packing?

....the sizes of gauge glasses?

....the thicknesses of valve gum?

Answers to the above and to hundreds of other such questions that come up daily in the engine room, are contained in "ENGINE ROOM SUPPLIES."

Fill out and mail the coupon. The book will be sent, FREE.

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QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS

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GARLOCK

PUMP VALVES

The service of pump valves depends upon the compounds as well as the consistency and cure of the valves. The compounds used in Garlock pump valves have been established after years of trial in actual service and under the most severe conditions. Pump valves should always be used for the purposes for which they are intended. The following are a few of our leading styles and grades of valves:

Style No. 139—For medium pressure cold water.
" " 175—For high pressure cold water.
" " 182—For warm or greasy water.
" " 108—For hot water.
" " 105—For boiling water.
" " 154—For air compressors and condensers.

We guarantee our pump valves to give satisfactory service when used under conditions for which they are intended.

THE GARLOCK PACKING COMPANY
HAMILTON, ONTARIO

Branches:

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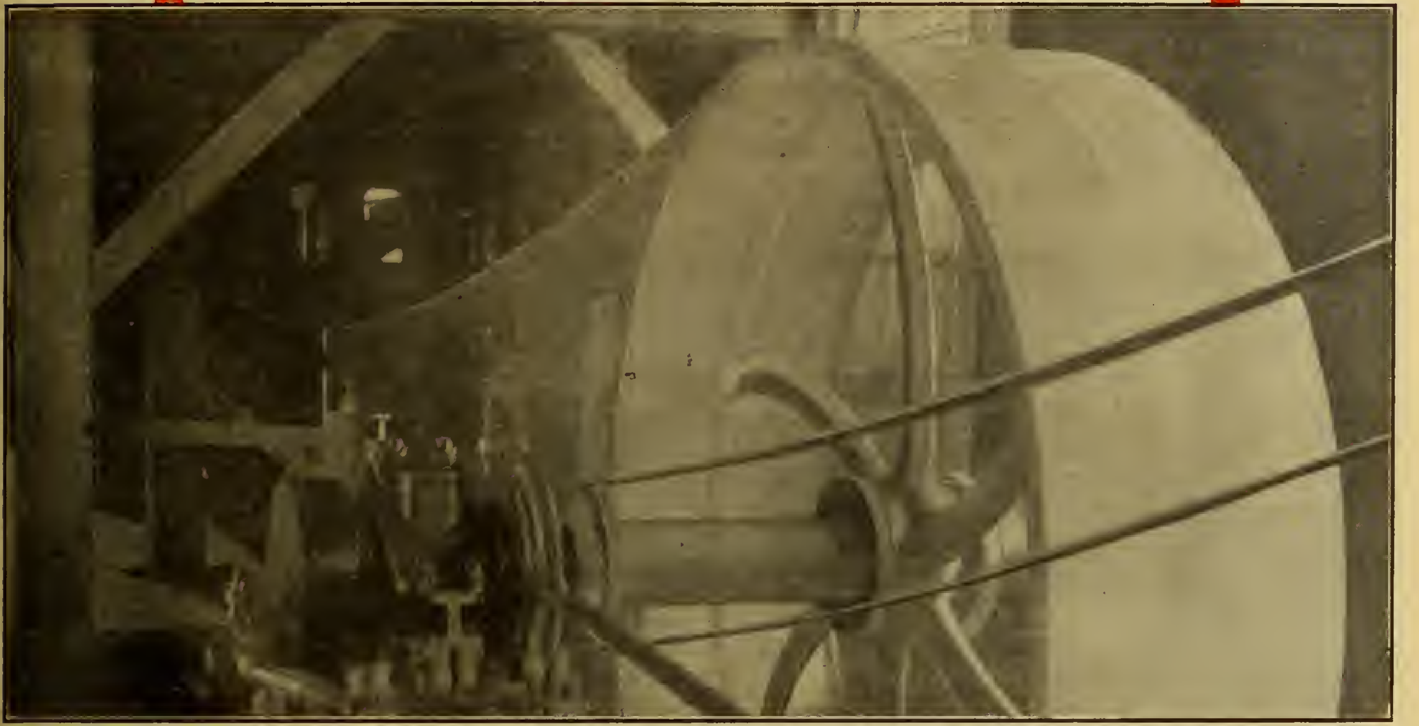
LEVIATHAN AND ANACONDA
ELEVATING
TRANSMITTING
CONVEYING
BELTING



A Leviathan Main Drive in one of the largest Pulp Mills in Canada. In service for five years. 24 in. x 6 ply.

No cost of upkeep; the belt has never been touched since the day it was installed.

When you begin to buy belting on the basis of service instead of price or habit, you are on the straight road to belting economy.

That's the way to buy

Leviathan and Anaconda Belting

You can depend on them for more certain service than any other belting you have ever used.

LEVIATHAN and ANACONDA have been sold on a "make good" basis for over thirty years. If they hadn't made good we would have been out of business long ago. The fact that our business is progressing rapidly is ample proof of the merit of this belting.

With every belt we guarantee full value in service, dollar for dollar, horse-power for horse-power, and just as we have figured our tables of horse-power for the best results, just so in making the above statement, we not only expect to give equal service, but BETTER SERVICE AND MORE ECONOMICALLY.

Why not give us a trial order and let LEVIATHAN or ANACONDA prove itself?

MAIN BELTING COMPANY OF CANADA

32 Front St. W., Toronto **LIMITED** **10½ St. Peter St., Montreal**

If any advertisement interests you, tear it out now and place with letters to be answered.

We can furnish a Belt for any purpose

Your plant can be operated economically with our Balata or Scandinavia belts.

Each of these belts has advantages of its own.

The belts shown on cut to the left are all Scandinavia belts. These give splendid service on machines of this kind. The edge is woven to resist wear of belt shifters, and the belts may be run straight or crossed without harm to the belt. These belts cost much less than leather and the service is good.

Our Balata Belting is as near stretchless as it is possible to have a good belt. It can be made endless. Can be run under any atmospheric conditions except heat.

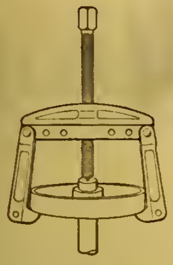
Extremely Strong

This is a splendid belt for drives where the load is intermittent, such as running compressors. Must not be used on belt shifters.

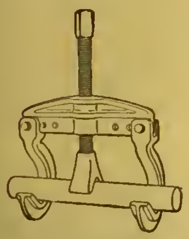
FEDERAL ENGINEERING CO., Limited

92 Sherbourne Street, TORONTO

Crane's New Model Patent Wheel Puller



Removing Work Near End of Shaft



Pipe Bending and Shaft Straightening Attachment

The screw has a flat end with inserted tempered tool steel point that will not spread cutters. Makes its own centre on work that has none. The strain is taken on the flat end of the screw. Grease to keep from cutting. The screws are made of high carbon steel and case-hardened all over.

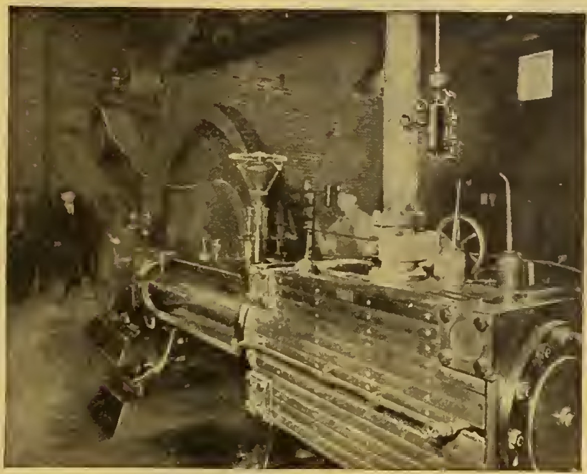
The pipe-bending attachment consists of a pair of arms and forked end for the screw. Two sizes to fit the No. 2 and No. 3 Two-Arm Puller. **It is indispensable in a repair shop** for straightening propeller and jack shafts, banding exhaust pipes, and removing universal joint yokes, etc.

We absolutely guarantee the workmanship and material in our tools.

Write for full particulars.

The Crane Puller Co.
54 Lake Street
ARLINGTON, MASS., U. S. A.

Canadian Distributors: Canadian Fairbanks-Morse Co., Montreal, Toronto, Vancouver, Winnipeg, St. John, Calgary; John Millen & Son, Montreal, Toronto, Winnipeg, Vancouver.



All Cling-Surface Users Talk the Same Way

"Best we ever used."
"Satisfactory, send 50 lb."
"Very profitable."
"Just what we want."
"Never saw its equal."
"A mighty good thing."
"Very much pleased."
"Used C-S ten years. It's O.K."
"Ideal in every respect."
"C-S ended our troubles."

Slack running Cling-Surface-treated belts which never slip assure greater transmitting capacity, saving of power, and relief to bearings, pulleys, hangers and shafting that have previously been overstrained by tight belts.

Cling-Surface puts and keeps belts in perfect condition by lubricating internal fibers, giving a clean clinging surface, waterproofing, and permanently preserving the original strength.

You don't have to heat Cling-Surface now before using. Send us a trial order and see for yourself what economies can be secured.

Ask for literature. We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

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1057 Niagara Street
Buffalo NY

I am interested in Cling-Surface and your trial order proposition.

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Firm ....

Street ....

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86

A practical method of reducing Fuse Maintenance Expense more than 80%

The stationary engineer who purchases or specifies electrical material has the means at hand to greatly reduce fuse maintenance expense while providing more than adequate protection for his plant.
There are thousands of

"ECONOMY"
Renewable Cartridge Fuse

users and millions of Economy Fuses in use.
Made in Canada and sanctioned by the Canadian Fire Underwriters' Association.
FREE SAMPLES of any desired types and capacities sent with catalogue 24. List of prominent users included.

ECONOMY FUSE & MFG. CO. OF CANADA, LIMITED
UNITY BUILDING - MONTREAL

Manufacturers in Canada of "S. & C." High Potential Fuses,—to 150,000 Volts.

Costs Less per day of Service

"CLIMAX"

Leather Belting

A belt which, when purchased, costs you less per foot than Climax, is not necessarily the cheapest belt.

The least expensive belt is the one that delivers the largest amount of power, day in and day out, and runs with minimum attention and depreciation per annum—the least cost per day of service.

"Climax" Leather belting may cost you a little more to buy because it costs us more to make. But, it is the least expensive IN THE END, and, therefore, the best investment.

WE CAN CITE INSTANCES WHERE OUR BELTINGS HAVE GIVEN FORTY YEARS OF EFFICIENT SERVICE. ASK US TO DO IT NOW.

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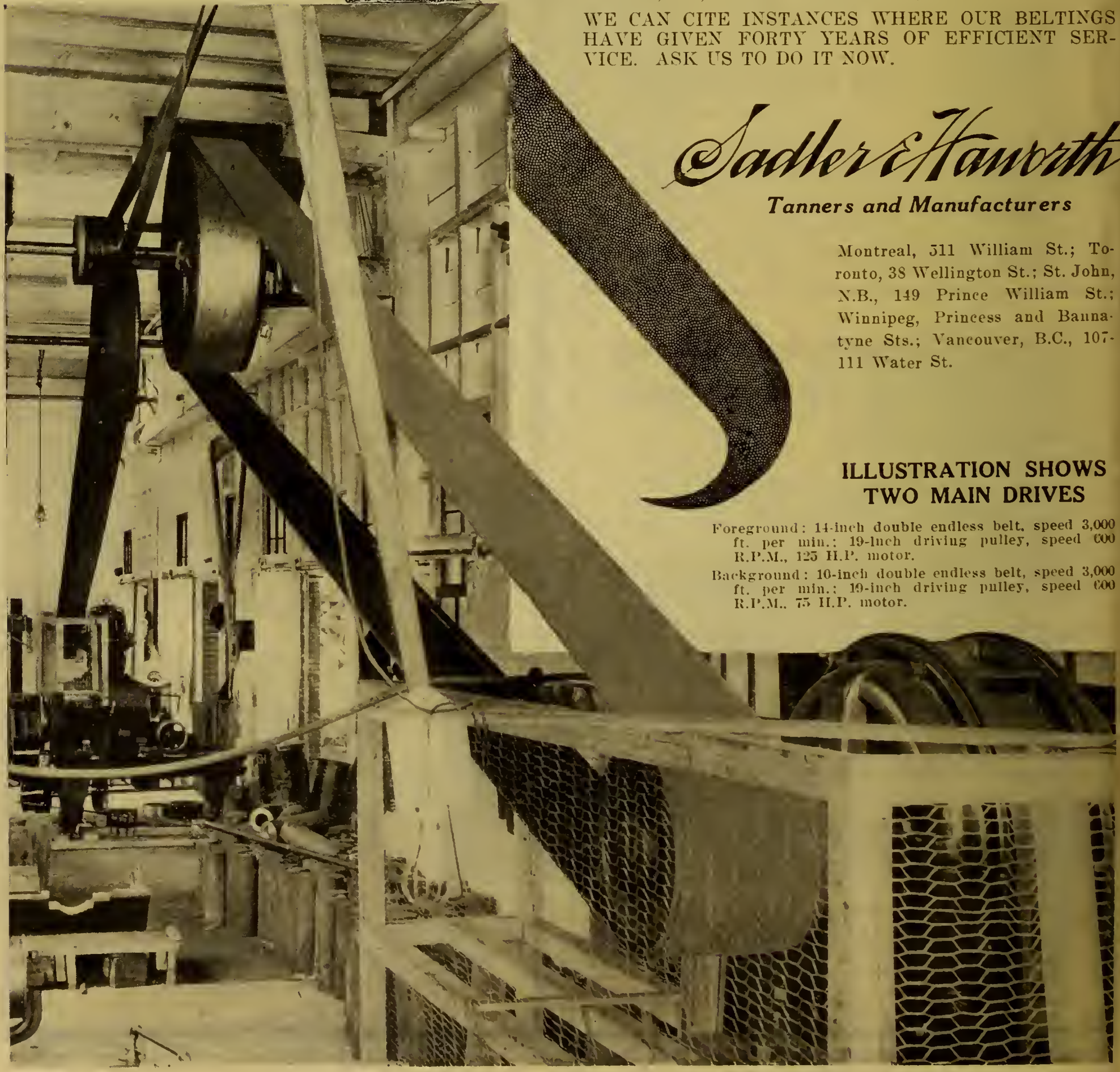
ILLUSTRATION SHOWS TWO MAIN DRIVES

Foreground: 14-inch double endless belt, speed 3,000 ft. per min.; 19-inch driving pulley, speed 600 R.P.M., 125 H.P. motor.

Background: 10-inch double endless belt, speed 3,000 ft. per min.; 19-inch driving pulley, speed 600 R.P.M., 75 H.P. motor.



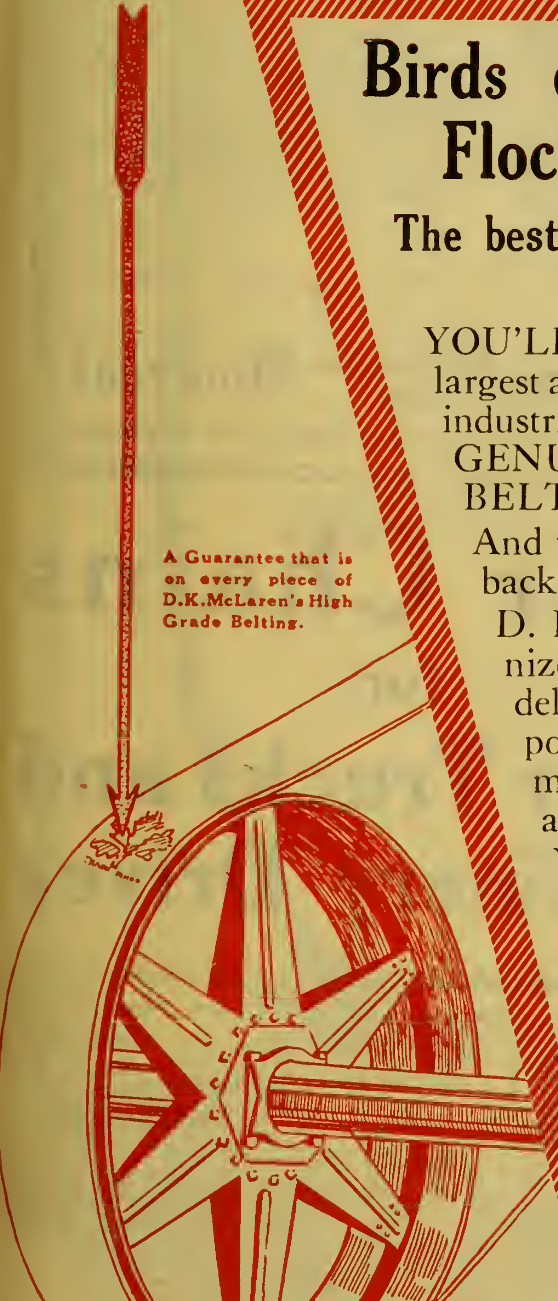
D.K.McLaren's

Genuine British Oak Tanned

Leather Belting

Genuine Oak

Genuine Oak



A Guarantee that is on every piece of D.K.McLaren's High Grade Belting.

Birds of a Feather Flock Together

The best plants use the best equipment

YOU'LL FIND many of Canada's largest and best equipped power and industrial plants users of our GENUINE OAK LEATHER BELTING.

And we see them coming back and back again for more.

D. K. McLaren's Belting is recognized as the best economy, because it delivers the greatest amount of power, is very durable, and minimizes power losses by its great cling and little stretch.

You will profit by asking us to put you in touch with users.

Don't delay — do it now, for what our belting does for others it will surely do for you.

D. K. McLAREN, Limited

Head Office and Factory:
351 St. James Street - Montreal, P.Q.

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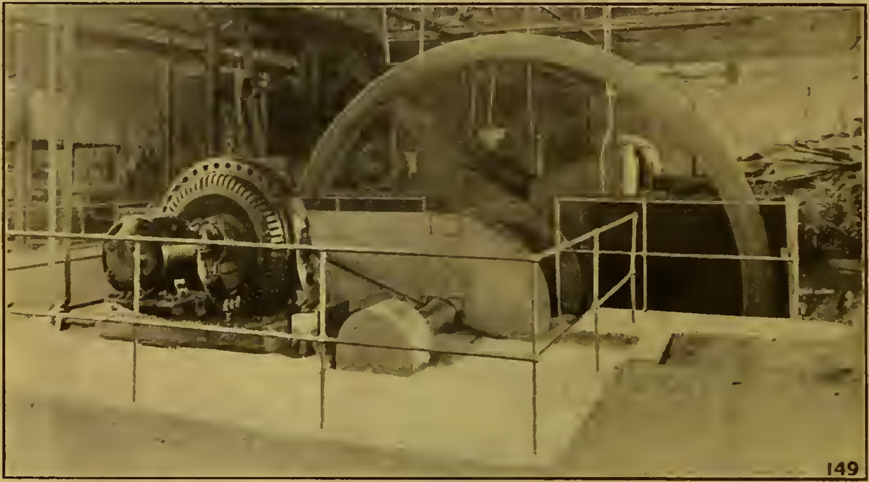
TORONTO. ONT.—194 King St. West. ST. JOHN, N.B.—64 Prince William Street. VANCOUVER, B.C.—847 Beatty Street. ENGINEERS SUPPLY CO.—123 Bannatyne Street, Winnipeg, Man. CALGARY and EDMONTON, ALTA.—Canadian Western Foundry and Supply Co., Limited.

RENOLD PATENT SILENT CHAINS

EFFICIENCY RELIABILITY DURABILITY COMPACTNESS



200 H. P. Renold Silent Chain Drive operating Generator from Water-Wheel Shaft in prominent Canadian plant.—Ratio of Speed increase: 1:7½.

Appreciation of the advantages of RENOLD Driving Chains is not limited to the Industrial World. This is best evidenced by the fact that for Municipal and Government work of all kinds, RENOLD Chains are a Standard Form of Power Transmission.

Write For Particulars.

Jones & Glassco (Reg'd), Engineers, Sole Canadian Agents **Montreal**

Branch Office: TORONTO

We Stock Chain and Repairs.

Baldwin Roller Chains

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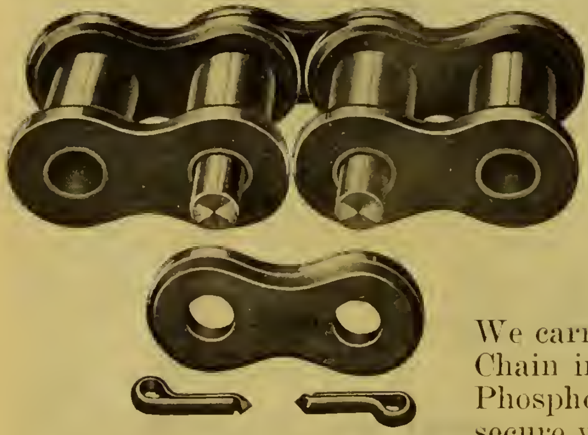
Motor Trucks and Machinery Drives



We carry in stock, for **immediate delivery**, this standard Roller Chain in Cotter Pin Detachable type. The Cotter Pins are of Phosphor Bronze, rust-proof, easily detachable, yet absolutely secure when inserted.

Baldwin Roller Chains give splendid service on Motor Trucks, Motor Cycles, Bicycles and Machinery Drives generally, where the linear speed does not exceed 1,200 feet per minute.

Full information on Roller Chains, their theoretical design, strength, practical uses, care, tables of standard sizes, and special styles, is at your disposal in a Booklet, "Baldwin Power Transmission Chains and Sprockets," which we will be glad to send you on request.

Lyman Tube & Supply Company, Limited

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The yearly sum you pay for oils. Is it so small, so insignificant that you can afford loose handling methods? Does it make no difference the amount of oil which never reaches your machines? Are you wasting it recklessly? These are questions which involve the same careful methods of economy applied elsewhere throughout your plant. Glance at the two sets of plates. Which illustrates the practice you are following? Total the money expended last year for the lubricants you consumed. Check up the amount you waste, isn't it well worth saving? Now, consider the value of proper storage equipment. Sum up the actual money you would save if **every drop** you buy were used for the purposes you intend it. At many times their cost you would still save by installing

BOWSER Oil Storage Systems

ESTABLISHED 1885

All grades of oil are higher than a year ago. Present indications do not point to lower prices. **Now** is the time to provide against needless costly waste; to insure yourself against it in the future.

Whether they be heavy oils, paint oils, varnishes, dryers, asphaltum, turpentine, lubricating oils, car oils, machine oils, valve oils or other grades, some equipment in the Bowser line has been designed to handle them correctly.

BOWSER SYSTEMS can be adapted exactly to your particular requirements and will meet unusual conditions satisfactorily. As evidence of this they may be seen to-day in thousands of industrial plants covering all lines of manufacturing work. One concern saves $10,000 a year on a system whose original cost was $6,267.00. Suppose the opportunity for economy in *your* plant was only a fraction of this, can you afford to continue the wasteful method any longer?

Our Engineering Department is acknowledged as the foremost authority on subjects pertaining to the storing, filtering, metering, circulating and handling of oils of all kinds. An inquiry for descriptive matter or information on anything along this line will not obligate you in the least.

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Engineers, Manufacturers and Original Patentees of Oil Handling Devices

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Run you plant on

Chapman Double Ball Bearings

YOU'LL SAVE POWER

The ordinary line of shafting consumes and wastes from 15 to 60% of power developed.

But the line shafting that's equipped with Chapman Double Ball Bearings will save 75% of the friction loads, making an average total saving of power from 15% to 30%.

Chapman Double Ball Bearings will greatly reduce your power cost, or if you are in need of more power they will give it to you at the present cost. They often eliminate the necessity of increasing the size of the power plant.

Oiling and attention are reduced to a minimum. Lubrication is only required twice a year.

Chapman Double Ball Bearings fit any adjustable hanger, and the change can be made with but little delay to you.

Used in over 2,000 Canadian Factories.

Write for full particulars.

The Chapman Double Ball Bearing Company
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339-351 Sorauren Avenue, Toronto, Canada
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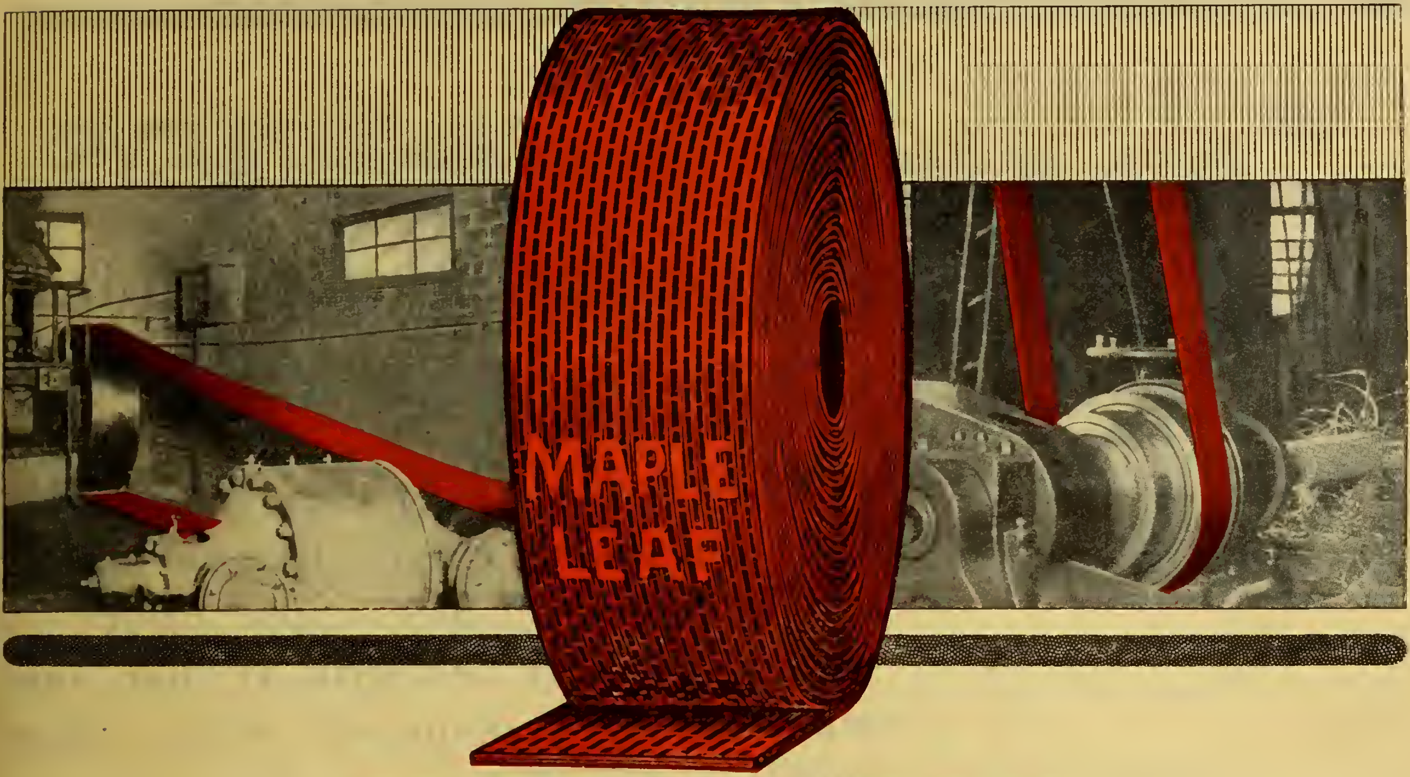


MAPLE LEAF
BRAND
Stitched Cotton Duck
BELTING

A good line to get acquainted with, both from the standpoint of efficiency and economy.

Costs less than Leather, Rubber or Balata Belting, but possesses unusual strength and durability.

At a recent test, Maple Leaf Brand Belting stood a breaking strain 50% greater than leather, and 25% greater than rubber.

It is positive in its grip on the pulley and is absolutely true running.

Try a belt and you'll be fully convinced.

MAPLE LEAF BELT DRESSING.

The Best for all kinds of Belts.

Dominion Belting Co., Ltd.

HAMILTON, CANADA

Quebec Branch—51 Duluth Building, Montreal

AMERICAN Steel Split PULLEYS

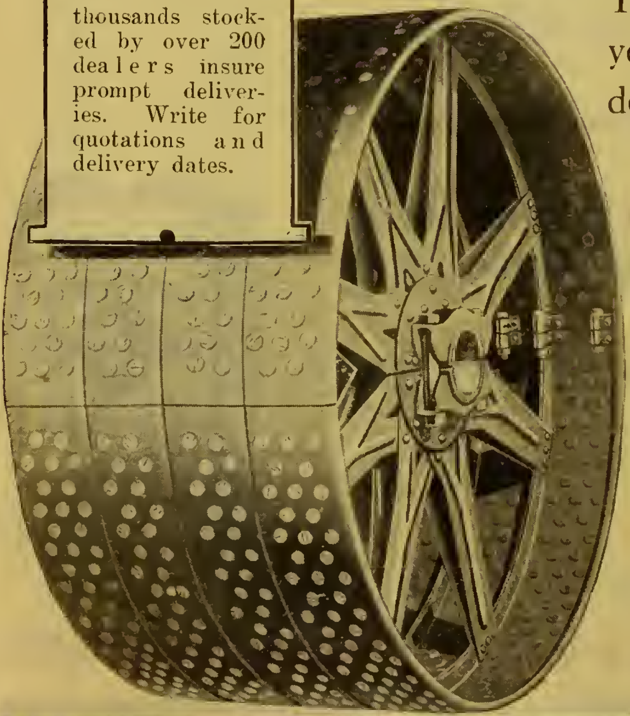
—with Cork Insets Tighten the Grip of the Main Belt

THIS cork inset pulley — in every other respect exactly like the standard "American" Steel Split Pulley — insures absolute belt grip at that "one time out of a thousand" when other pulleys *might* slip.

It is made to take the load of the main drive belt and transmit *all of it*. So the cork insets are put in. They *hold* the belt. Belt slip is reduced to a negligible factor.

The insets will wear almost as long as the pulley.

These pulleys have been on the market several years and have given splendid satisfaction. They deliver the power—with minimum loss.



Over 60,000 pulleys—3 in. to 120 ins. in diameter—stocked in factory, warehouse and branches, and additional thousands stocked by over 200 dealers insure prompt deliveries. Write for quotations and delivery dates.

American Pulley Company
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Canadian Representatives:

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St. John, N.B., Toronto,
Winnipeg, Vancouver.

"Lincona"

Balata Belting

Manufactured by
JAMES DAWSON & SON, LIMITED, Lincoln, England

The Belt with a GRIP—

Balata Belting is in a class by itself, and is used on many drives so difficult that they defy every other type of Belting. "LINCONA" is the strongest Balata Belt Made.

The secret of the greater strength of "LINCONA" Balata Belting is in making the Balata a fluid which will saturate the duck, instead of a paste placed on and rolled in. The fluid Balata used in the "LINCONA" process also allows the duck to be compressed more closely, so producing a Belt thinner for the number of plies. This gives a stronger wearing surface to the pulley and less friction.

"LINCONA" Balata Belts under tests show an average breaking strength of 11,700 lbs. per square inch.

Lincona Balata Belting will pick up a load suddenly better than any other type of Belting. The tensile strength is almost double that of a leather belting. Lincona Balata Belting improves with age. It stretches less and runs straighter than any other type of belting. It can be exposed to snow, rain and every condition of weather without injury. It can be run in water without trouble.

GET THE MAXIMUM TRANSMISSION OF POWER

Write us about your specific needs.

The Canadian B. K. Morton Co., Ltd.

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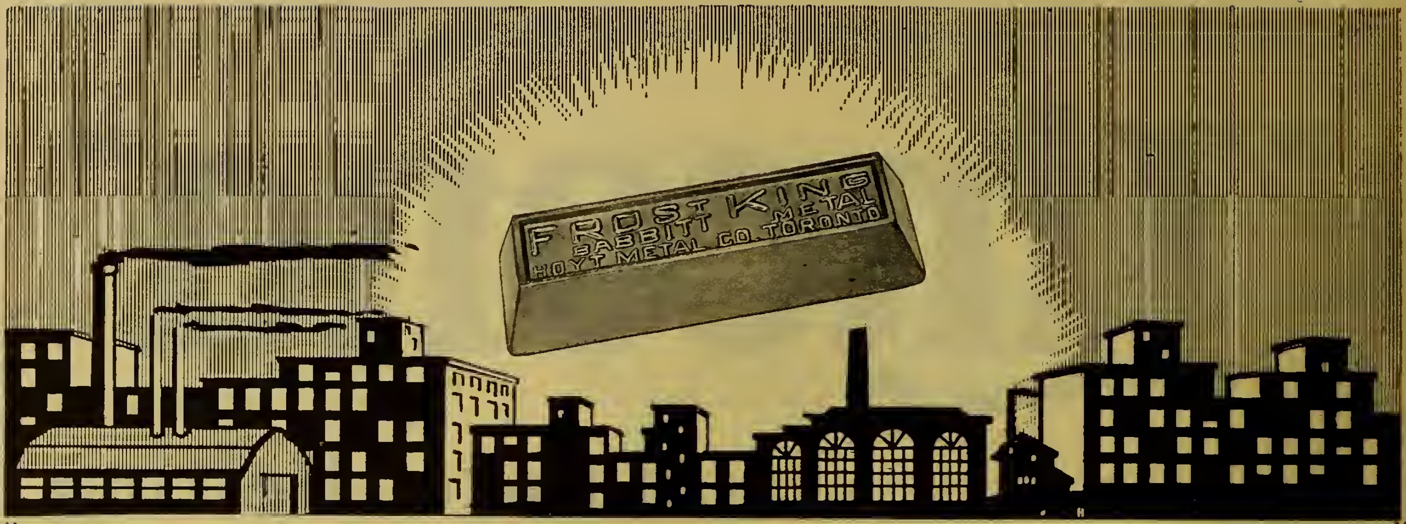
MONTREAL

86 Richmond St. E.
TORONTO

Austen Bros., Ltd., Halifax, N.S. Sherwood & Fraser, Ltd., Winnipeg, Man. Western Oil & Supply Co., Vancouver, B.C.



"Hoyt Frost King"

LIGHTENS THE BABBITT EXPENSE OF THE POWER PLANT

It's a babbitt with 40 years' experience in metal mixing and a thorough knowledge of modern requirements built right into it.

Its service means cool, non-friction and lasting bearings.

It is specially mixed for high-speed machinery and engine work, saw mills, threshing engines, traction engines, pumps, rolling mills, pulp machinery and all classes of *stationary* engines.

For babbitting dynamos and motors you'll also find our "DYNAMO GENUINE" a top-notcher in results.

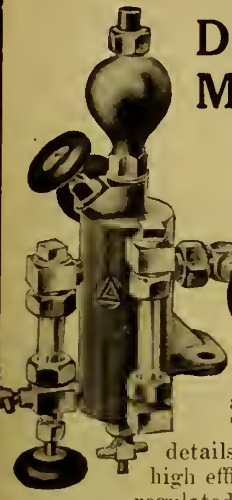
A trial of these babbitts will convince you that they are as perfect as experience and knowledge can make them.

We will send catalogue on request.

Hoyt Metal Company, Toronto, Ont.

FACTORY AND OFFICE: Eastern Avenue and Lewis Street

New York, N.Y. London, Eng. St. Louis, Mo.



Detroit Lubricators Meet Demands of Every Kind of Service

They are scientifically designed in a sufficient variety of styles and kinds to properly lubricate the valves and cylinders of all types of steam engines, steam pumps, gas engines, air compressors, etc.

The greatest care is given to all details of manufacture to insure uniformly high efficiency. They provide constant, evenly regulated and economical lubrication. There is nothing of the "hit or miss" about them. Send for our catalog L1 to-day. It contains much valuable information upon lubricating devices and will be sent upon request.

THEIR efficiency holds over half the world's trade.

Makers of the Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

DEPENDABLE LUBRICATION

Service of high efficiency and low cost, with every bearing in your plant working cool and easy, is secured with

ALBANY GREASE

Why not let us send you a quantity of Albany Grease, a cup, and try it? There will be no charge. Just drop us a card.

Your dealer sells Albany Grease ; if not, order direct

Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868

TRADE MARK

A GOOD DEMONSTRATION OF MAGNOLIA'S WORTH UNDER TRYING CONDITIONS

Magnolia Metal Co., Hancock, Mich., March 4th, 1916.

Dear Sirs,—Your letter of recent date received. I have had considerable experience with Magnolia Metal, and if the following is of any interest, you are at liberty to use it if you see fit:

In 1911 I was appointed chief engineer of the Yacht "Maderia." On taking charge of it I was told that the main shaft bearing was a trouble maker. This bearing was located 38 feet aft of the crank shaft bearing, and near the shaft tunnel. The shaft was 6" in diameter, and the average revolutions were 95 per minute. The shaft I discovered, whipped more or less and the construction of the hull was such that installing an extra bearing meant a large expense as well as considerable lost time. All grades of babbitt had been tried but none of them was successful.

The bearing had a large opening on top, and for a few days I worried along on tallow and graphite as a lubricant. This, however, failed on a trip from Havana to Key West. On arrival at the latter port I ordered some Magnolia Metal and rebabbitted the bearing. The trouble ceased at once, and instead of keeping it sludged with oil and grease I purchased a compression cup, and four or five ounces of grease were sufficient for a day's run.

During my nine years' experience as a Marine Engineer, and five as a Stationary Engineer, I have never known Magonlia Metal to fail, and always recommend it for use especially under severe conditions.

The chief engineer of the Old Court Street Electric Light Station in Buffalo, told me one time, during my apprenticeship, that there was only one high grade babbitt and that was Magnolia Metal.

Yours very truly,
R. C. DE MARY.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c. post paid.

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SOLD BY LEADING DEALERS EVERYWHERE OR BY

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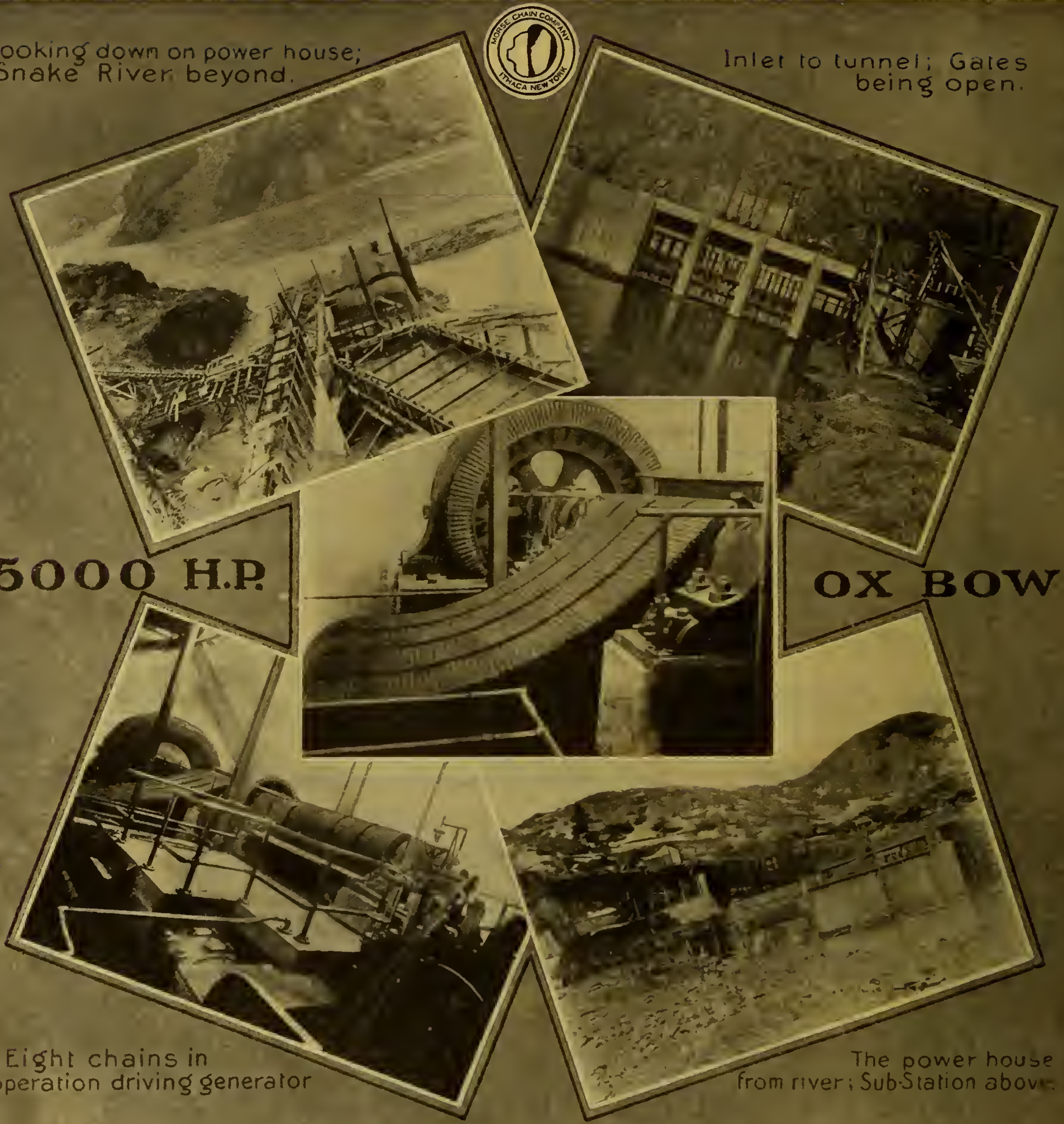


Looking down on power house; Snake River beyond.

Inlet to tunnel; Gates being open.

5000 H.P. **OX BOW**

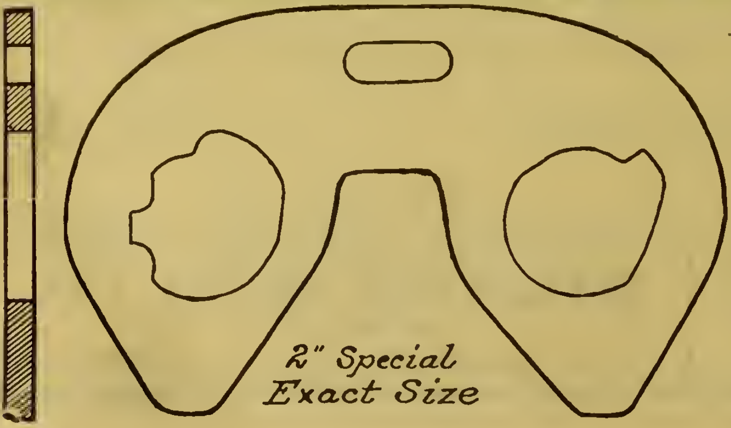
Eight chains in operation driving generator

The power house from river; Sub-Station above.

Largest Silent Chain Drive In The World, 1914

This and many other large power chain drives described in detail in our Publication No. 14. Write for a copy.

Morse Chain Co., General Office & Works, **Ithaca, N.Y.**



191,520 steel links of this size were required for the eight chains composing the above drive.

Each chain is 21" wide by 31.67' long. The eight chains cover an area 14 by 31.67 feet, or 21" by 253.36 feet.

Total weight of eight chains, assembled, 21282 pounds, of eight double sprockets 43200 pounds.

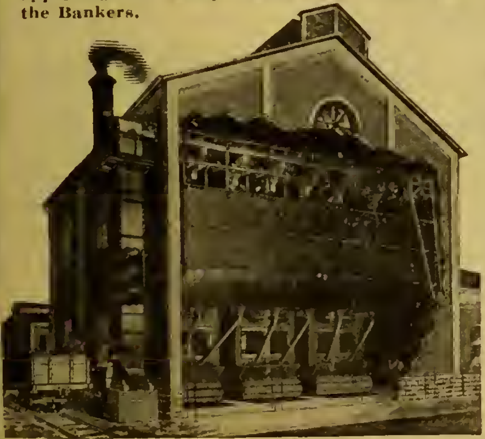
Other information furnished on request.

MORSE CHAIN CO., ITHACA, N. Y.

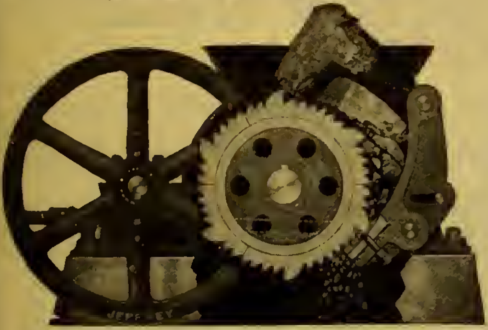
Handling Ashes with a Jeffrey Drag Chain Conveyer.

Single Strand Chain Coal Scraper Conveyer mounted on rollers.

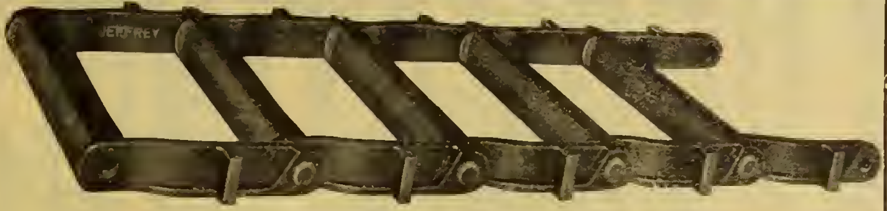
Upper Run of Jeffrey V-Bucket Conveyer over the Bankers.



A Combined Elevator-Conveyer V-Bucket System which has given years of hard service. Coal passes direct to elevator or first through Jeffrey Single Roll Crusher beneath tracks and then to elevator.



A Single Operation reduces Run-Of-Mine Coal to 1" and under.



JEFFREY "RELIANCE" DRAG CHAIN

← This type of chain operating in a cast iron trough, as illustrated in the opposite photograph, is proving highly Economical and Efficient in the handling of Ashes, Clinker, and other abrasive materials.

For Large and Small Power Plants

JEFFREY

Coal and Ashes-Handling

MACHINERY

Is the "Recognized Standard" for Economy and Reliability on account of its Simple Construction, Ease of Operation and Low Cost of Maintenance.

The **JEFFREY V-BUCKET ELEVATOR-CONVEYER** is especially adapted for handling Slack and Stoker Sized Coal. Can be used either as a Run-A-Round Scraper Conveyer or as a combined Elevator and Scraper.

For Large and Medium Sized Plants, the **JEFFREY PIVOTED BUCKET ELEVATOR-CONVEYER** insures a maximum of service at minimum cost to the user, in the handling of both Coal and Ashes.

Our numerous Catalogs and Bulletins fully illustrate and describe the Service Application of Jeffrey Elevators, Conveyers, Weigh Hoppers, Valves, Spouts, Coal Crushers, Pulverizers, Screens, Power Transmission Machinery, Haulage Locomotives, Wagon and Truck Loaders, etc.

Get the benefit of our many years of operating and field experience. Our Engineering Experts are at your disposal in solving your Coal and Ashes Handling Problems. Write to

The Jeffrey Manufacturing Co.

Canadian Branch and Warerooms, Montrea

← The Jeffrey Single Roll Crusher

Guarantees a Constant Supply of Right-Sized Stoker Coal at a Minimum of Cost.

Send for Descriptive Bulletin No. 141-4

Power House

TEAR HERE

The Jeffrey Mfg. Co., Montreal, Canada.

Please send Catalogs on Coal and Ashes Handling Machinery.

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LUBRICATING OILS

It is an acknowledged fact that our Quality First oils, grease and compounds mean an actual saving in dollars and cents.

1. **By saving your machinery through perfect lubrication.**
2. **By giving you perfect lubrication at minimum cost.**

We are the largest independent manufacturers of oils, greases and compounds in Canada.

We refer you to such concerns as the CANADA CEMENT COMPANY with branches throughout Canada; the MOND NICKEL COMPANY, Coniston, Ontario, largest nickel manufacturers in the world; the ALGOMA STEEL COMPANY, Sault Ste. Marie, Ontario, and hundreds of the largest manufacturers throughout Canada who are receiving perfect lubrication at minimum cost by using our Quality Oils.

Write for a description of the Erg-Aer-Rew Atomizer which we furnish free with a positive guarantee to save you 25 per cent. in the cost of your cylinder lubrication.

Our YUCATAN BOILER COMPOUND will thoroughly cleanse your boilers of scale and cut your fuel bill in two.

Canadian Oil Companies, Limited

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THAT'S SAWYER STITCHED CANVAS BELTING

Quality Stands Out Like The Name After Twenty Eight Years of Hard Work

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"A good concern to do business with"

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Goes Right on Your Present Valve Wheel

"Goes on" is about right, too, it's so easy to apply, and by putting a

Babbitt Adjustable Sprocket Rim

on each of those hard-to-get at overhead valves you can save a lot of time you now spend in hunting ladders and all the risk you now run in using them after you've found them. One concern that thought two would do, bought 27 in a little over two months. The price will encourage you to have enough of them.

Ask your dealer. Write for Illustrated Folder.

Babbitt Steam Specialty Co., 59 So. Water Street, New Bedford, Mass.
The R. E. Cleaton Co., 20 St. Nicholas St., Montreal, Que.

Polson

Marine and Land

Boilers

We build all kinds of Marine and Stationary Boilers, Marine and Stationary Engines. Also all kinds of tanks, like those shown in the lower illustration, steel vessels, barges, tugs, dredges, scows, etc.

All kinds of plate work.

Send us your specifications and blue-prints.

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SHIPBUILDERS, ENGINEERS AND BOILERMAKERS
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Sliptivity SteamCylinder

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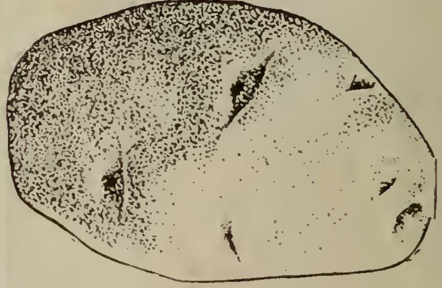
OILS

These Lubricants give remarkable service. They will keep your machinery running smoothly, easily and with a minimum of wear and cost.

No better time than now to put them to the test. The prices are very reasonable.

Potato Scale Powder Boiler Cleanser



Will positively rid your boilers of old scale and will *keep* tubes clean if but a small amount is fed daily through the feed water.

Eliminates foaming, pitting or any other boiler troubles due to impurities in the water supply. *Makes big reduction in fuel bills.*

Sold UNDER A POSITIVE GUARANTEE. Try a Barrel.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

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Good things for the POWER PLANT

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TRADE MARK

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PROTECT the Owner, Manager, Superintendent, Foreman and Employee by reporting with unfailing accuracy every variation of important Pressures, Temperatures, or Speeds—Settle disputes —Leave no chance for an argument—Place the blame when things go wrong or helps to boost when things are well done.

Investigate why "Foxboro" Recorders will increase the efficiency of your Power Plant or Factory.

Our Engineering Department is at your Service.

Write for Bulletin No. BH-96.

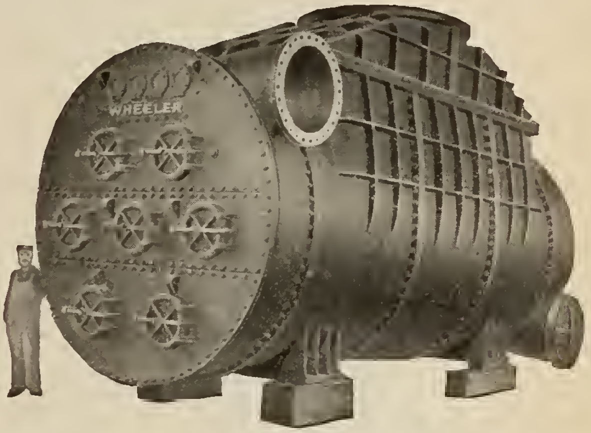
THE FOXBORO COMPANY
Foxboro, Mass., U. S. A.

Or PEACOCK BROS.
59 Beaver Hall Hill - Montreal

MADE IN AMERICA

WHEELER

Surface Condensers for High Vacuum



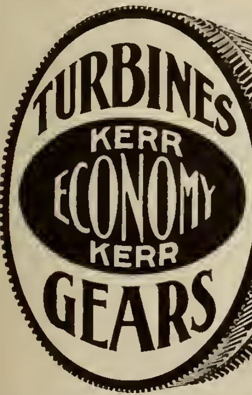
THERE are two fundamental requirements for attainment of high vacuum with surface condensers.

First, a design which insures the distribution of the steam to ALL of the tube surface. Wheeler High Vacuum Surface Condensers are designed so that the entering steam is distributed evenly over the top of the condenser, and liberal tube spacing insures penetration of the steam to all of the surface.

The second fundamental requirement is thorough air removal, secured at the greatest economy by using the Wheeler Turbo Air Pump. This pump will evacuate the normal air leakage of a large condenser and turbine, at vacuums above 99% of the theoretical.

With Wheeler condensers you can maintain vacuums averaging approximately 29 inches the year round. Send for Bulletins P.H. on Wheeler Surface Condensers Wheeler Turbo Air Pumps, and if you have not already obtained a copy, our "STEAM TABLES FOR CONDENSER WORK."

Wheeler Condenser & Engineering Co.
Carteret 126 New Jersey



'Kerr Economy' Equipment is Good Insurance

'Kerr Economy' Steam Turbines mean less steam consumption, lower cost of maintenance, fewer repairs, less attention, better satisfaction. Send for our bulletins. 'Kerr Economy' steam turbines geared and direct connected to generators, pumps, blowers, etc., and for belt drive. **Specify 'Kerr Economy' and protect your investment.**

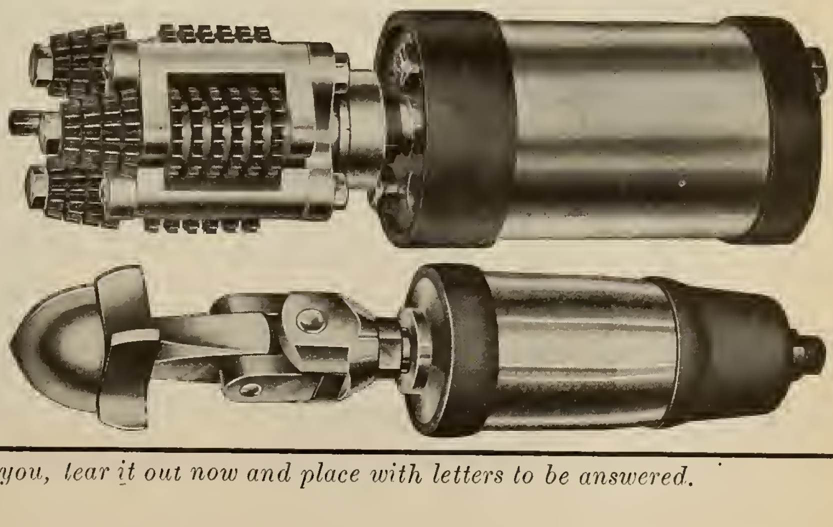
Kerr Turbine Company
WELLSVILLE, - - - - - NEW YORK
Agents in Toronto, Montreal, Vancouver, and all large cities in the United States.

ROTO TUBE CLEANERS

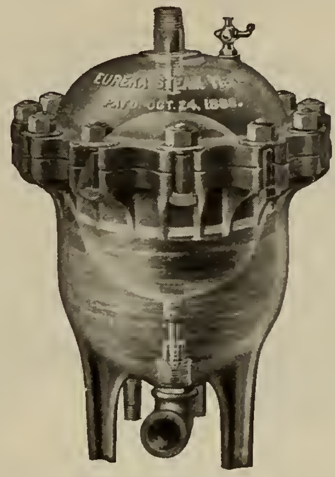
Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.
The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.

THE ROTO COMPANY
Write for Catalog HARTFORD, CONN.



The Eureka Steam Trap



The Eureka Steam Trap is of simple construction, working from atmospheric to 250 lbs. pressure.

This Trap has a self-seating valve, so that it is always in working order, having no parts to get out of order. The valve is either wide open or entirely closed.

Sold on 30 days' trial.

For further particulars write

The Foss & Hill Machinery Co.

305 St. James Street MONTREAL, QUE.

"We are protecting this steel work RIGHT"

"WE are using the same paints in this building of yours that were used on the Pennsylvania Station, the Metropolitan Tower and the Hell Gate Bridge in New York. They are the greatest steel preservatives ever invented, and are known as

TOCKOLITH AND **R.I.W.** REMEMBER IT'S WATERPROOF

THE PATENTED CEMENT PAINT DAMP-RESISTING PAINT

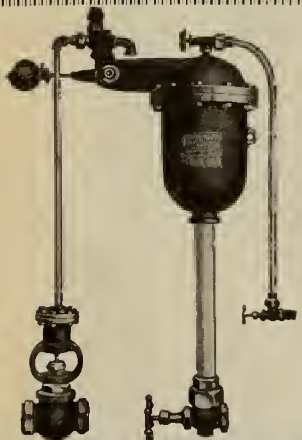
Tockolith, in drying, liberates lime and in this way deposits a hard cement coating on steel. It combines with incipient yellow rust when present, stopping further oxidation.

Tockolith and a finishing coat of R. I. W. Damp-Resisting Paint keep steel work in perfect condition.

Write for Tockolith Booklet from Dept. 59.

Manufactured in Canada by

R. I. W. DAMP-RESISTING PAINT CO.
TOCH BROTHERS
Gerrard St. and Carlaw Ave.
TORONTO, ONTARIO, CANADA



THE VIGILANT
FEED WATER REGULATOR

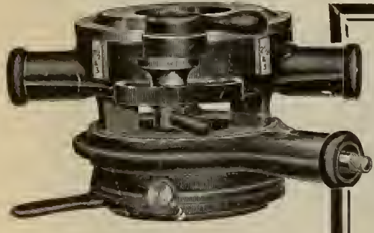
TAMES WILD BOILERS

The **Vigilant** has proved to engineers all over the country that floats are not only unnecessary but very objectionable. The best of them will leak and become water logged or collapse in spite of all guarantees.

The **Vigilant** is the simplest and most reliable feed water regulator made. There is nothing to get out of order; all working parts can be seen at a glance; is easy to install and can be **depended upon** to keep the water level always at its proper point regardless of the demands for steam.

Sixty days' free trial.
Write for full particulars.

THE CHAPLIN-FULTON MFG. CO.,
28 Penn. Ave., Pittsburgh, Pa.



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Ratchet Die-Stock No. 102-R, six sizes, ¼ inch to 1¼ inches.

Made in many other convenient sizes.

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are the tools with the famous 5 Big Oster Features — (1) self-locking dies, (2) self-locking guides, (3) no running back over newly cut threads, (4) no loose bushings, (5) no breakable small parts. For a complete and illustrated description ask for book. "THE BULLDOG TALE."

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THE PLANT BEHIND

DEARBORN FEED-WATER TREATMENT

Dearborn Methods

Hit the Mark

PRESENT day experience recognizes the necessity of correcting Boiler Feed Water Problems according to scientific methods.

DEARBORN METHODS consist of making a thorough and careful analysis of the feed water, thereby ascertaining the kinds of substances which it contains and the quality of each, a thorough consideration by our engineering department of conditions existing in the plant, and finally the construction of a formula for treatment; the forwarding of such formula to our manufacturing department, where the preparation is put together under the direct and personal supervision of those having not only years of experience in the manufacture of our preparations, but also a thorough knowledge of applied chemistry, which enables them to intelligently and properly compound the substances called for by the formula, with our complete and thorough equipment, consisting of the most suitable and modern appliances for preparing chemicals which we are unable to buy in the open market, thereby eliminating the possibility of the presence of impurities which would prove objectionable on account of the ill-effects which they would have; specially devised kettles mixers, etc., for the cooking and intimately mixing of the constituents of the treatment, thereby assuring that the finished product will contain the proper quantities of the desired reagents or chemicals and obviating the possibility of the treatment containing any substance or substances which could in any manner carry over with and contaminate the steam, or in any way impair the steam cylinder lubrication, or the quality of the steam for purposes where live steam might be used.

DEARBORN WATER TREATING PREPARATIONS are scientifically prepared to meet the requirements of the mineral ingredients and other objectionable constituents of the water, the percentage of each mineral salt governing the percentage of the antidotal ingredient in the treatment. By these methods we avoid the use of an excess or deficiency of any part of the treatment, every pound being utilized in the reactions taking place. There is no mechanical, unknown, or unlooked for result obtained from the use of our goods; we cause a complete chemical reaction to take place between the deleterious constituents of the water and the ingredients of our preparations.

Samples of Water as Received for Analysis.

GREATER EFFICIENCY

ELIMINATE

BOILER TROUBLES

SATISFACTION

NO MATTER WHAT the type or size of your boiler may be, Dearborn Service will give you increased steaming capacity and effect important economies.

IT'S ONLY GOOD BUSINESS for you to investigate any proposition which promises big economies and big gains in operating efficiency.

SEND a gallon sample of feed water for analysis.

MADE IN CANADA

Dearborn Chemical Company of Canada
LIMITED
1220-30 Dundas St., Toronto, Ont., Canada

Money Saved—Work Made Easier

Considerable money can be saved and the engineer's work made much easier if the correct method of handling condensation in the boilers be adopted.

There are three things which are desirable in a device of handling the condensation.

1. It shall remove the condensation so efficiently that the boiler tubes shall be free for the live steam.
2. There should not be any stop-cocks to open, any engine to watch, any pump to keep oiled. It should be absolutely automatic so that the engineer shall be free to attend to other duties.
3. It should return the condensation to the boiler at as near the boiling point as possible, so that use is made of every available heat unit.

The "Detroit System" offer a positive method of removing the condensation from boilers and returning it at a temperature but a couple of degrees below the boiling point.

The "Detroit System" is absolutely automatic and it uses up no power in returning the water to the boilers—a big advantage over the pump and receiver method. Moreover, the water is returned directly to the boiler without giving it any time to cool.

The engineer who works for his employers' best interest will recommend the "Detroit System" as it saves many hundreds of dollars yearly in fuel.

Some one of the "Detroit Systems" will solve any problem in handling condensation ever encountered in actual business practice.

Write for full information on the "Detroit System" for handling condensation. It is found in Steam Trap Book No. 14-A.

CANADIAN *Sirocco* COMPANY
LIMITED

WINDSOR, ONTARIO.

(5)

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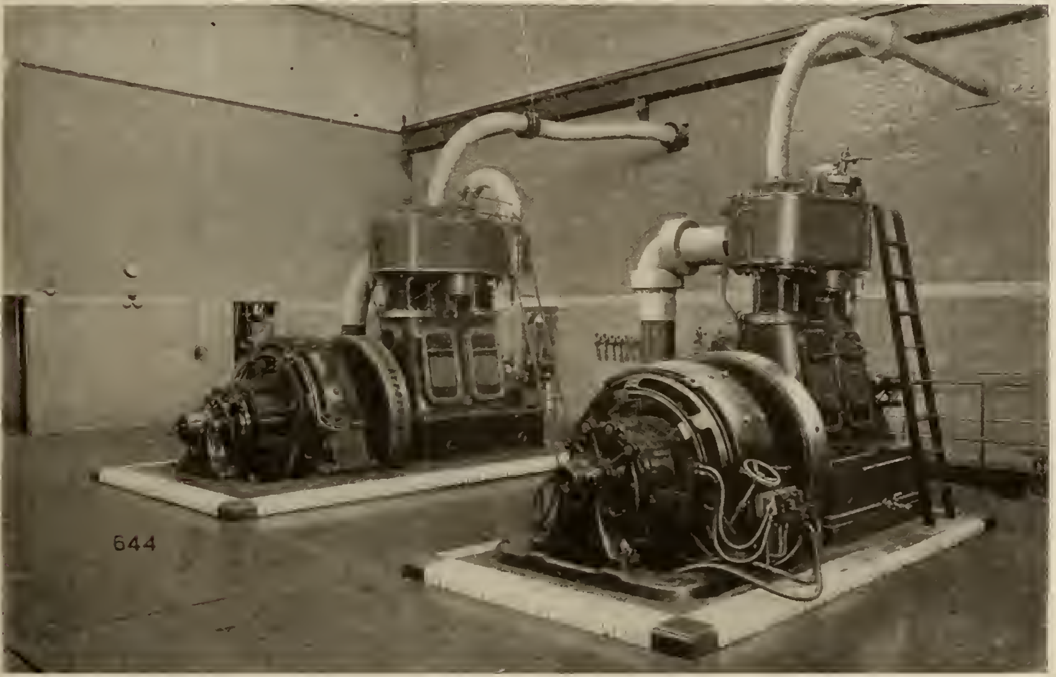
BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Engines installed in McGill University Power House
Total Horse Power, 1010 B.H.P.

We have for immediate delivery several Engine Generator Sets. Write for Particulars.

Send Us Your Enquiries For

- Steam Engines
- Gas Engines
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Complete Power Plants Designed and Erected.

LAURIE & LAMB

Engineers

211 Board of Trade Bldg. :-: :-: MONTREAL

The "Anderson" Safety Water Column

THE utility of this mechanism is that it is an efficient method of giving warning when the water in the boiler falls below or rises above the danger mark.

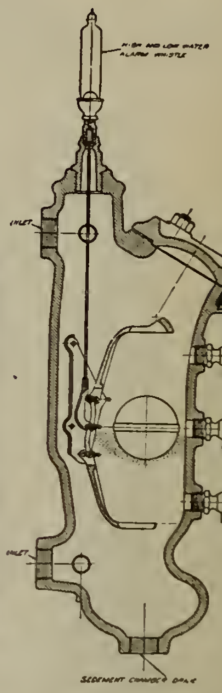
THE entire mechanism of this Water Column is assembled as a single unit in an independent, removable hanger frame and hung on accurately machined bronze pivots. The working parts cannot rust or stick.

Write for full details.

The V. D. Anderson Co.
1935 West 96th St., Cleveland, Ohio

With High and Low Water Alarm

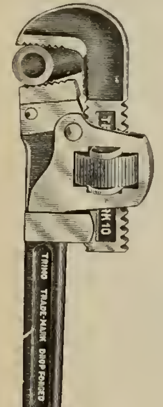
Exterior



Cross Section

The Wrench of 25% Greater Efficiency

TRIMO PIPE WRENCH



Two new features have been recently added to the Trimo Pipe Wrench, namely Nut-Guards, in all sizes, and unbreakable steel frames, in leading sizes.

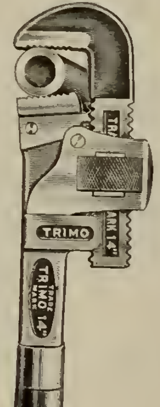
The Nut-Guards prevent the accidental rotation of the nut while in use.

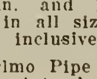
These improvements add 25% to the usefulness of the tool.

The Trimo Pipe Wrench is made with wood handles in 4 sizes, 6-in., 8-in., 10-in., 14-in. and in steel handles in all sizes, 6-in. to 48-in. inclusive.

All Trimo Pipe Wrench parts are interchangeable.

The inserted jaw in the handle can be readily replaced when worn, thus adding to the life of the tool.





Nut with Nut-Guards

Inquiries from Importers and Dealers Solicited. Send for Catalogue No. 55.

TRIMONT MANUFACTURING CO.

Cable Address: Triwrench
Code: Western Union

Roxbury (Boston) Mass., U.S.A.

For Use in Power Machines

THE IMPORTANCE of durability in hack saw blades is obvious to all manufacturers and superintendents. Durability is entirely a question of quality. Starrett Hack Saws are the result of long study of the right quality for every sort of work. Order hack saws by the table in the Starrett catalog and the result will be economy.

Write for Free Catalog No. 21-C.D.

The L. S. Starrett Co.
ATHOL, MASS.
"The World's Greatest Tool Makers"
London New York Chicago

STARRETT TOOLS TRADE MARK REG. U.S. PAT. OFF.

Mention this paper when writing advertisers. It will identify the proposition about which you require information.

If you tried one brand of tobacco and it failed to satisfy your taste, would you stop smoking?

Certainly not—you would keep on trying until you got the right kind.

But you have tried boiler compounds and because they have proved failures you have gone back to the old time-wasting and expensive (chipping out) method of getting rid of your scale.

Try, Try again. Try "PEROLIN," it always makes good. Over 30,000 progressive engineers are steady users. Think it over.

Perolin

Made in Canada

Boiler Metal Treatment

is not a boiler compound and therefore is superseding all other methods for the elimination of scale because it acts mechanically, not chemically; removes the scale and prevents the possibility of new formation.

"PEROLIN" soon loosens old scale so that it can be readily washed out and a small amount used daily will keep your boilers clean indefinitely. Scale and boiler troubles become ancient history.

"PEROLIN" is sold under positive guarantee to end scale troubles, regardless of feed water conditions, and it makes good or does not cost you one cent.

Worth trying, isn't it? Write us to ship you a barrel by freight prepaid.

Perolin Company of Canada, Limited

Office and Factory: 858 Dupont Street, Toronto, Canada

Western Agents: The Engineers Supply Co., Winnipeg. The Western Supply & Equipment Co., Ltd., Calgary and Edmonton. Bayfield & Archibald, Vancouver, B.C. Quebec Agency: 30 St. John Street, Montreal.

Direct Current is More Adaptable

Install DeLaval Geared D.C. Turbo Generators

THE steam turbine is preferred because of high efficiency, simplicity, small cost of upkeep, freedom from vibration, adaptability to all steam conditions, absence of oil in the exhaust, and low first cost of machinery, foundations and buildings. Direct-current is the best means of distribution, giving flexibility of speed control, simplicity of wiring, less danger and less expensive motors.

The De Laval Speed Reducing Gear enables you to use the steam turbine efficiently for producing direct current, as it is thoroughly reliable and highly efficient, its design and the methods of manufacture having been perfected by over 20 years of experience.

Frequently more power can be obtained with little or no cost for fuel by the use of De Laval Turbines of the mixed flow or bleeder types, the former where the exhaust steam from other units is available, and the latter where steam at low pressure is required for heating or drying, or in manufacturing processes.

De Laval Steam Turbines are applied to driving high, medium and low-speed machinery, as alternators, centrifugal pumps, blowers and compressors, rolling mills, paper machines, and rope and belt drives, and can be coupled to existing shafting.

Our Engineering Department will supply suggestions for the best and most economical arrangement for your plant upon receipt of particulars.

Ask for Publication No. 61.

DE LAVAL
Steam Turbine Co.

Turbine Equipment Co., Limited,
C.P.R. Building, Toronto, Can.

The E. Laurie Co., 243 Bleury
Street, Montreal, Can.

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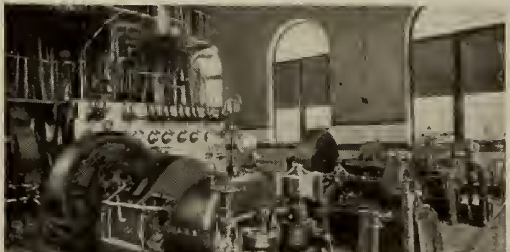
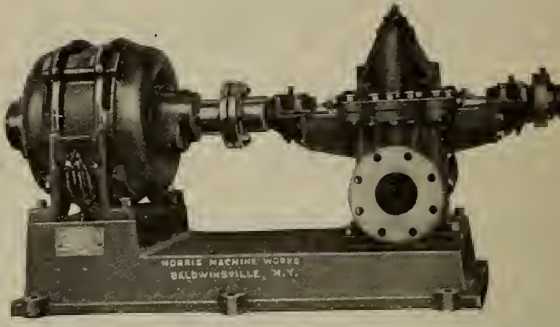


Two De Laval 200-kw. direct-current geared turbo generators supplying current to two vertical variable speed, motor-driven pumps which lift water to the filter bed of the Trenton Filtering Plant at the rate of 20,000,000 gals. per day. Reliability of operation in this plant is essential.

Morris Pumps



The horizontal shaft double suction pump illustrated above was designed to meet the demand for a high efficiency pump. It is also built multi-stage in sizes from 2″ to 20″ discharge.

Our 126 PAGE MORRIS BOOK is free. Better send for it—To-day.

Morris Machine Works Baldwinsville, N.Y., U.S.A.

Builders of Centrifugal Pumps, Hydraulic Dredges, Steam Engines

Canadian Sales Agents:
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Improved "VULCAN"
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lately awarded the P.P.I.E. "Grand Prize," has double-ended, reversible jaws, machine-tested chains and full chain contact, which insure long life, complete safety and total absence of crushed pipe. Your dealer will supply them in seven sizes that accommodate from ⅛ to 12″ pipe.

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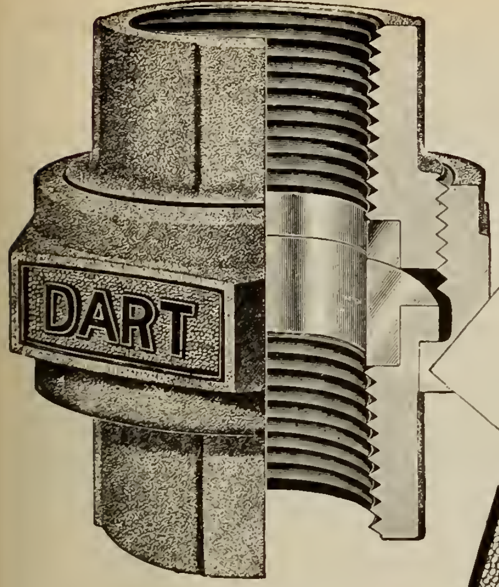

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The DART'S Efficiency is practically everlasting, because the Bronze faces cannot deteriorate, and the heavy iron parts will not stretch or pull apart. The ball-shaped seat allows for an easily made and perfectly tight connection whether pipes are in or out of alignment.

Easily Connected

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no upkeep cost—no replacement cost, and no loss from leaks.

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If any Union on which is cast the word "DART" is defective, send it to us or your jobber, and you will get two new ones for it.

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THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

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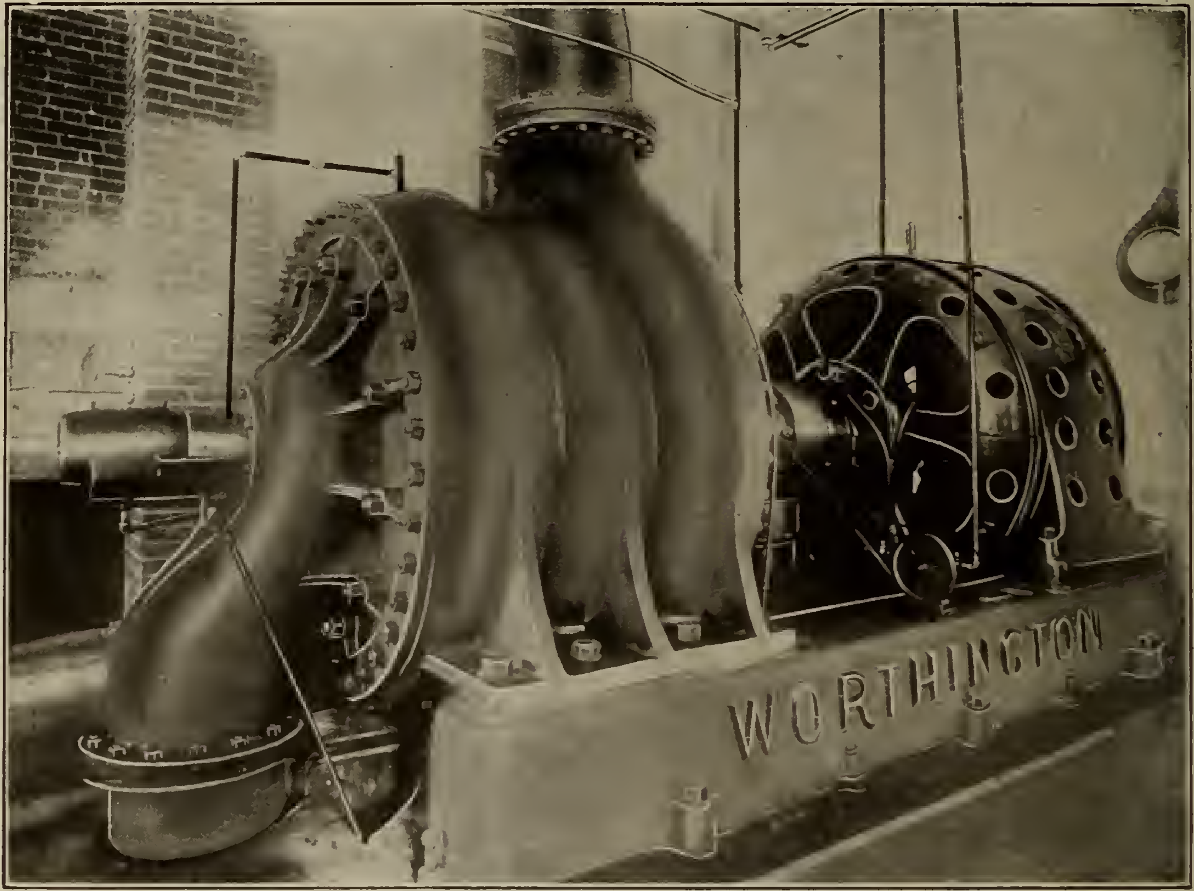

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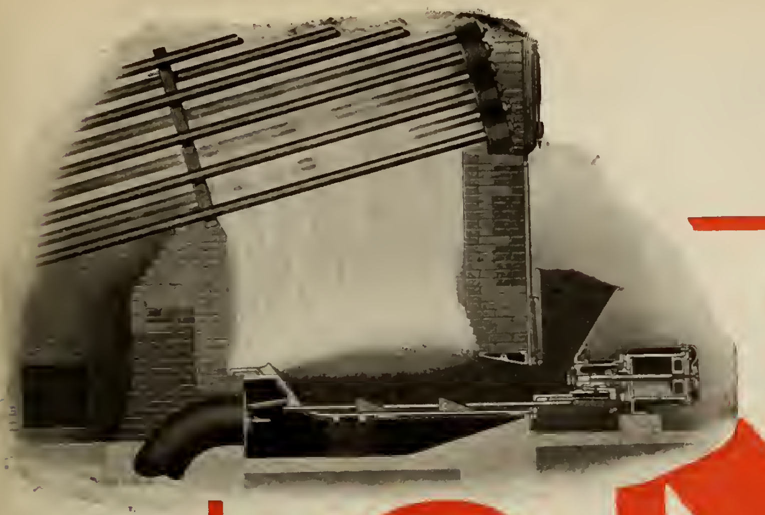

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UNDERFEED STOKERS

burn the cheapest grades of coal efficiently, without smoke. They respond instantly to load fluctuations and automatically maintain a uniform steam pressure.

Furnaces equipped with Jones Stokers are sealed —no loss from sifting fine coal. No half-burned coal. All fuel must deliver all its heat in the furnace before going to the refuse pipe. Only non-combustible matter is to be found in the ash-pile.

Combustible in the ash runs from 30% to 60% in many plants not equipped with Jones Stokers—yours may be one of them.

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are built upon the idea of quality, service and economy. Each design is the best of its kind known to modern engineering and each pump carries a *National guarantee.*

Made in Duplex and Simplex types for any pumping requirement.

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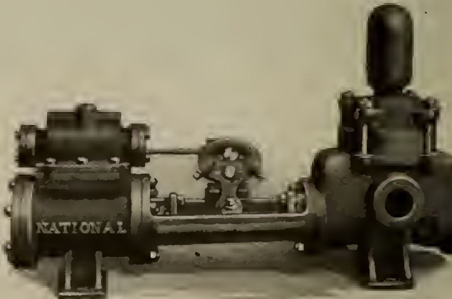

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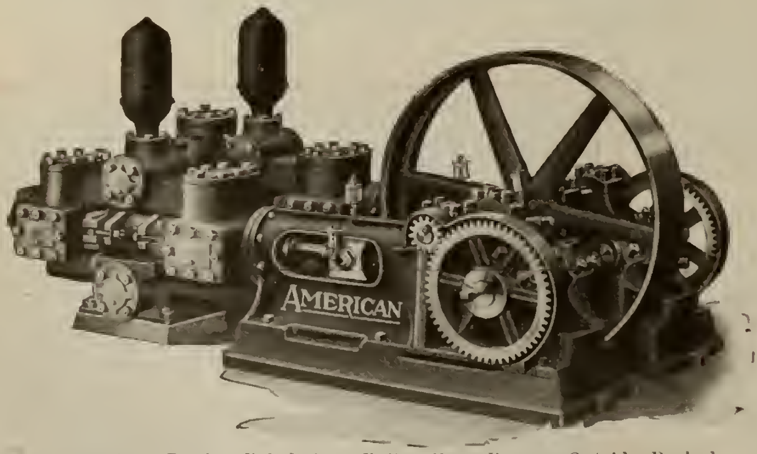
NATIONAL STEAM PUMP CO., Upper Sandusky, Ohio

MARSH and AMERICAN

Pumping Machinery. Steam and Power Driven

The world has used and endorsed over 130,000 Marsh and American Pumps. Twenty-seven years of pump manufacture have proved our ability and perfected our facilities. Marsh and American Pumps are 100 per cent. correct—from the selection of raw material and accuracy of design to the actual pumping service, day in and day out, year after year. They ask no apologies and never have to explain away any error in service or failure in efficiency.

Investigate. Ask for our 250-page catalog illustrating and describing the line. Your pumping problems will be answered fully and satisfactorily through this investigation. This catalog will be sent by return mail in answer to your inquiry. Your copy is awaiting your prompt request.



American Duplex Belt-Driven Boiler Feed Pump. Outside Packed Plunger Pattern.

AMERICAN STEAM PUMP COMPANY

BATTLE CREEK, MICH.

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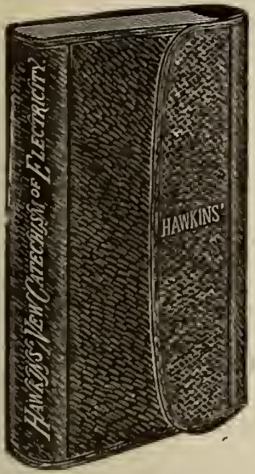
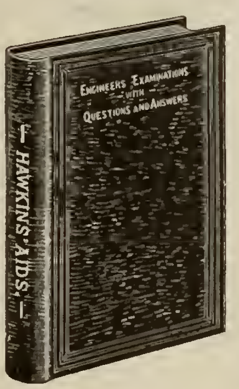
Taylor Engineering Co., Ltd., Vancouver, B.C.

Books for the Engineer's Library



Hawkins' New Catechism of Electricity

It contains 550 pages with 300 illustrations of electrical appliances; it is bound in heavy red leather, with full gold edges and is a most attractive handbook for electricians and engineers. One third of the book is devoted to the explanation and illustrations of the dynamo, with particular directions relating to its care and management.—$2.00



Engineers' Examinations

By N. Hawkins, M.E.

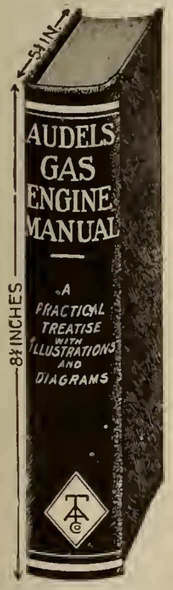
It presents in a condensed form the most approved practice in the care and management of steam boilers, engines, pumps, electrical and refrigerating machines, with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the steam engine and steam boiler.—$2.00.

Steam Turbines

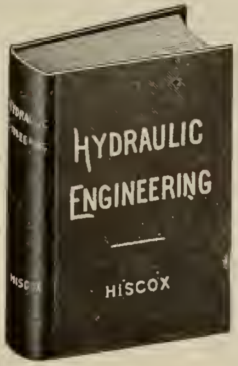
By Leland.

A reference work on the development, advantages and disadvantages of the steam turbine; the design, selection, operation and maintenance of steam turbine plants and turbo-generators. 135 pages. Illustrated.—$1.00.

Audel's Gas Engine Manual



A practical treatise relating to the theory and management of gas, gasoline and oil engines, including chapters on producer gas plants, marine motors and automobile engines.—$2.00.



Hydraulic Engineering

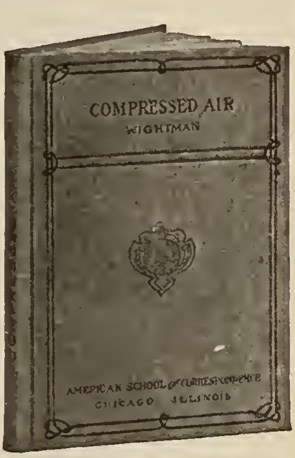
By G. D. Hiscox.

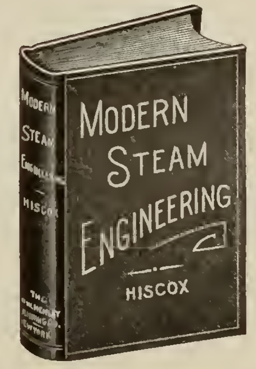
This comprehensive book of Hydraulics written by an experienced engineer, is a practical treatise on the properties, power and resources of water for all purposes, including the measurement of streams, the flow of water in pipes or conduits; the horse power of falling water; turbine and impact water wheels; wave motors, etc. All who are interested in Water Works Development should have a copy. 320 pages, 305 illustrations. Price, $4.00.

Compressed Air

By L. I. Wightman, E.E.

A reference work on the production, transmission and application of compressed air; the selection, operation and maintenance of compressed air machinery; and the design of air power plants. Illustrated.—$1.00.





Modern Steam Engineering in Theory and Practice

By Hiscox.

This book has been specially prepared for the use of the modern steam engineer, the technical students, and all who desire the latest and most reliable information on steam and steam boilers, the machinery of power, the steam turbine, electric power and lighting plants, etc. 450 pages, 400 detailed engravings.—$3.00.

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The only book showing how locomotive boilers are built in modern shops. Shows all types of boilers used; gives details of construction; practical facts, such as line of riveting punches and dies, work done per day, allowance for bending and flanging sheets and other data that means dollars to any railroad man. 421 pages, 334 illustrations, six folding plates.—$3.00.

Compressed Air, Its Production, Uses and Application. *By G. D. Hiscox, M.E.*

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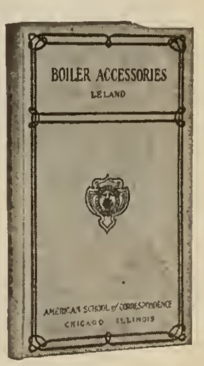

Assistant Professor of Naval Architecture, Mass. Institute of Technology, American Society Naval Architects and Marine Engineers. 144 pp., 80 illus. Cloth binding. A treatise giving complete descriptions of the various accessories of the boiler room and engine room essential to economical operation, such as evaporators, pumps, feed-water heaters, injectors, mechanical stokers, etc., with practical instruction in their use.—Price $1.00.

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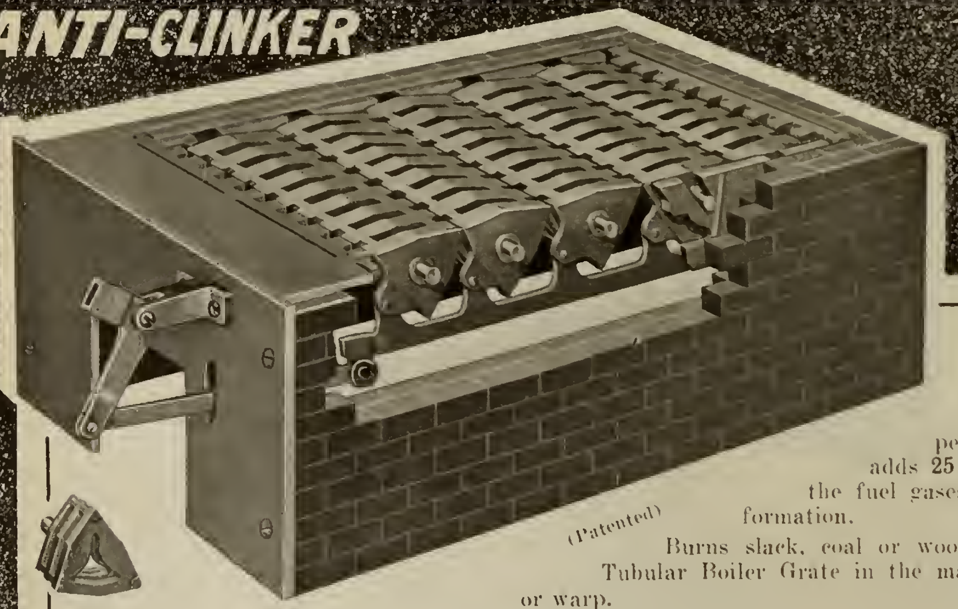

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SHELL BAR GRATES

60% of the total fire surface is air space. This abundant air supply commands a perfect combustion which adds **25 per cent. more heat** to the fuel gases and prevents clinker formation.

Burns slack, coal or wood. The only revolving Tubular Boiler Grate in the market that cannot twist or warp.

Two grates in one.

By pressing the lever you turn and change the grates, breaking up the coal and giving you a clean fire. **You will profit by getting full details before installing that new grate. Drop us a line now.**

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York Refrigerating Machines

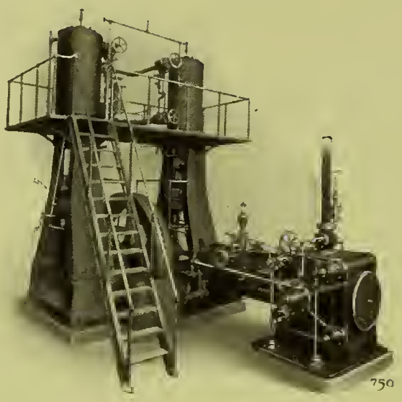
have a distinctive character all their own — in Workmanship, Durability, and Efficiency.

They embody many features not found on other Machines, and yet they are sold at a conservative price—by reason of our large output.

If you are looking for a reliable Machine—one that will give satisfactory results under the most exacting conditions—you can not afford to overlook the YORK line of Ammonia Compression and Absorption and Carbon Dioxide Machines.

We are prepared to give you the type of Plant best suited to meet your local needs.

Write for information and prices.



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JAMISON'S "JONES" and "NOEQUAL" doors are SUPERIOR because :

1st—Only the best materials are used in their construction.

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3rd—Our doors are built with double and triple seals of contact—others have but one.

4th—Our Automatic Self-Tightening Fastener is the only truly AUTOMATIC and SELF-TIGHTENING Fastener on the market.

5th—Our ADJUSTABLE SPRING Hinges mean the door is always properly seated in the frame, making sagging impossible.

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Vilter Rolling Mill and Girder Corliss Engines, Poppet Valve Engines, Ice Making and Refrigerating Machinery, "Badger" Pasteurizers for Pasteurizing Milk or Beer In-The-Bottle. Machinery for Breweries and Bottlers, etc.

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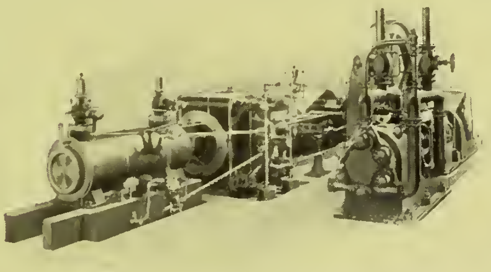
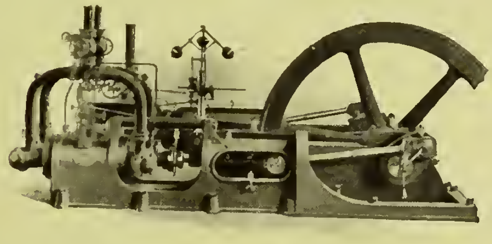
Vilter Poppet Valve Engines effect real power plant economy. We know our statement will be attested to by owners and operating engineers of the plants where Vilter Poppet Valve Engines have been installed. Your request for proof need entail no obligations to purchase.



Vilter Tandem Poppet Valve Engine, direct connected to a Vilter Ammonia Compressor.

Vilter Rolling Mill Type Ammonia Compressor

The Rolling Mill Type Compressor is built along very heavy lines and for all conditions of service. It is used only with slight modifications in all sizes of compressors. The general design is very pleasing to the eye, the machine making an artistic asset to any engine room. Its very appearance gives assurance and proof of its strength and reliability. This type is built in sizes from 6 Tons to 25 Tons daily refrigerating capacity.



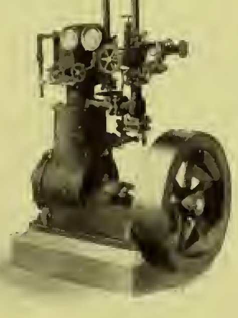
Rolling Mill Type Compressor.

Vilter Duplex Heavy Duty Ammonia Compressors

A Duplex steam-driven unit, with horizontal double-acting ammonia compressors and direct connected to Cross Compound Corliss Engine. Compressor equipped with multiple valve heads, giving maximum area. Stuffing box of the double-packed type, with oil seal and pressure release. The duplex type is built in sizes from 125 to 750 tons.

Vilter Small Capacity Vertical Ammonia Compressor

A vertical single-acting compressor, specially designed for users of comparatively small quantities of refrigeration. Made in both single and duplex units. The single units, either belt or steam driven, are made in sizes from 1 ton to 12 tons daily refrigerating capacity. The duplex units, belt driven only, are made in sizes from 2 tons to 25 tons daily refrigerating capacity.



Vertical Ammonia Compressor.

Vilter Rolling Mill Type Corliss Engine

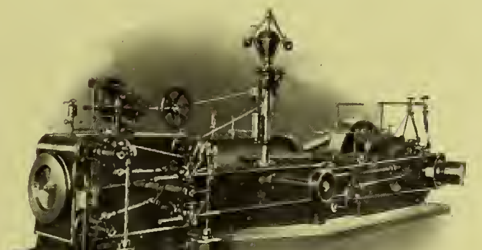
The Rolling Mill type Corliss Engine is of exceptionally massive construction throughout, and is adapted to any class of service from the steady belted load to the direct connected electrical service, in which the engine is subjected to heavy and extremely variable loads. It is built for high steam pressures, and high rotative speeds, and may be used with superheated steam up to 100° F. superheat.

Vilter Girder Frame Corliss Engine

is exceedingly strong and rigid, and is designed to take shocks and overloads without possibility of misalignment. Made in 26 sizes, from 25 h.p. up.

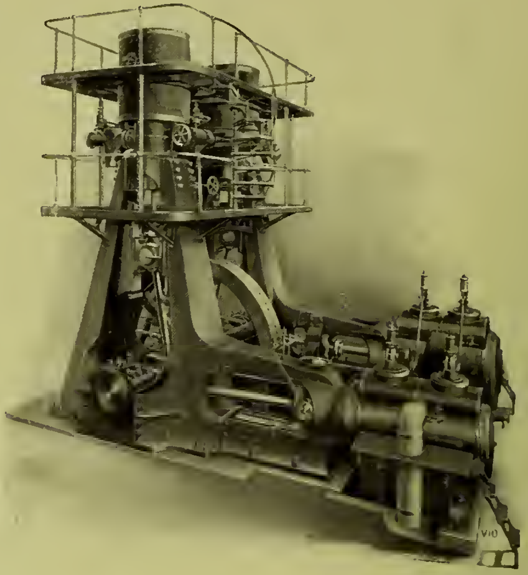
The "Badger" Pasteurizer

A machine of wonderful simplicity for pasteurizing beer or milk in the bottle. Made in any capacity and of various styles to fit the requirements.



Rolling Mill Type Corliss Engine.

LITERATURE. Bulletins, catalogues and full data regarding our products will be mailed upon request.



Preparedness Insuredness
Safety First

Regardless of the word used, the meaning is the same.

If you want to **prepare** for the hard summer season;

If you want to provide **safety**, reliability, long life and low repair costs for your plant;

You must secure a machine built for hard usage—one that goes and keeps going when you need it most.

Frick Machines are built particularly for this service.

Write us and learn how you can get proof of it.

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:
THE FRICK ICE AND REFRIGERATION COMPANY, 357 St. Catherine Street West, Montreal

When 4½ Inches Equals 45 Inches

If you built your boiler setting walls 45 inches thicker than they are now, using fire brick and common brick, they would hold much more heat in the boiler, reduce your fuel bills and keep your boiler room cooler. But instead of adding all this extra brick work, you will get the same results by replacing one course of common brick with a single 4½-inch course of

Nonpareil Insulating Brick
For Boiler Settings, Furnaces, etc.

When you use Nonpareil Brick in all the walls and arches of the boiler settings you don't increase the thickness and take up valuable space. But you do save 65% or more of the heat that ordinarily is lost by radiation, and the fuel saving will pay for the brick in less than a year.

Tops of boilers insulated with Nonpareil Insulating Brick, Central High School, Detroit, Mich.

Many engineers are not waiting until they rebuild the old settings or install new boilers to use Nonpareil Insulating Brick. They are putting a 4½-inch course on the tops of the settings and over the steam drums now. It will pay you to do the same.

Sample and full information on request.

Armstrong Cork & Insulation Co., 504 McGill Bldg.
LIMITED
Montreal, Que.

Also manufacturers of Nonpareil Cork Covering for all cold pipes and Nonpareil High Pressure Covering for steam lines.

The Publisher's Page

To Our Subscribers

THIS issue of THE POWER HOUSE is our **Annual Directory Number.**

In this Number we have endeavored to gather together for your information and convenience, the announcements of the leading manufacturers and dealers in power equipment and supplies. It will prove extremely valuable as a guide in selecting your purchases for the ensuing year.

You will find a cord attached by which you can hang your copy conveniently in your office, engine room, or home.

Every manufacturer or every dealer may not be represented in this issue, but from the lines advertised in our **Annual Directory Number** you can make a very wise and satisfactory choice.

> I have been a constant reader of the articles that have appeared in the POWER HOUSE for upwards of ten years, and I think I have been amply repaid by the additional knowledge that I have gained during that time about the different articles reviewed therein. I am also a subscriber to various other books of similar nature, but I consider the POWER HOUSE to be far ahead of them all in instructive value.
>
> I may also say that the "ad." section has helped me considerably. I have purchased various POWER HOUSE advertised goods for the various firms by which I have been employed, and by so doing I have kept the machinery up-to-date, and also been the means of saving considerable sums of money. It is needless to say that I shall keep up my subscription to the POWER HOUSE, as I would not be without it.
>
> Yours respectfully,
>
> (Sgd.) J. CARMICHAEL,
>
> Chief Engineer for the Montreal High School.

Study the various announcements carefully. Consider each line on its merits, and with a view to its application and utility in your own plant. If you think that the purchase of certain equipment will increase the efficiency of your power plant, and save your employer some real money, take the matter up with him at once. If he is the right sort of man, he will listen to you, and pleasantly consider what you have to say.

If your plant is put into action, and really results in increased efficiency and economy, you will have earned a double reward, because you will have a better power plant and a fatter pay envelope. No employer will deny a well-earned increase—of that we feel sure.

Keep this copy of THE POWER HOUSE till next year's Directory Number is in your hands. Study the advertising pages, and apply the information they impart to the needs of your power house. You will find it exceedingly profitable.

You will know that, being represented in a reputable journal like THE POWER HOUSE, the firms whose advertisements appear in this issue are reliable, and that they have, moreover, sufficient confidence in their own products and sufficient faith in the future to advertise and appeal for your business in this important number.

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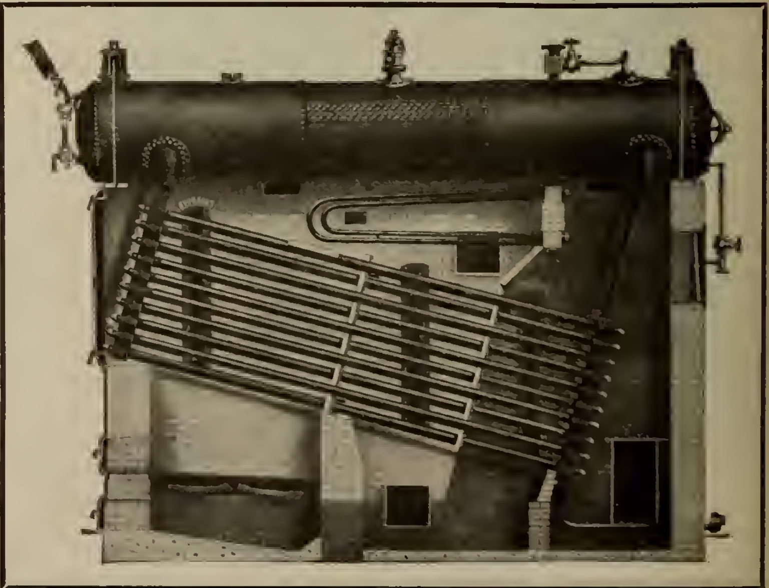

No. 1 Mine Power Plant The Western Fuel Co. Nanaimo, B.C.

By A. F. Menzies

The power plant and accessory equipment described and illustrated in the accompanying article constitute an installation which is more or less distinctive, both from its operation point of view and from its service application. Power plants—central station, or attached to general manufacturing establishments, have at least the option of using coal purchased on their own specification. In a coal mining enterprise it is necessary, for various reasons, that much of the unsaleable product be consumed under the boilers of its own steam power plant.

CLOSE to the shore at Nanaimo, Vancouver Island, is situated the shaft of what is known as No. 1 mine, the oldest coal mine in British Columbia. It is operated by the Western Fuel Co. and has been in operation since 1883. Increased output and modern methods have from time to time necessitated additions to the power plant. The coal seams extend under the bed of the harbour and a shaft has been sunk on Protection Island, about two miles from the original mine. The shafts are connected, and while the majority of the miners going to work are taken to Protection Island on a scow, the coal is practically all hoisted through No. 1 shaft.

Boiler Installation.

The power plant is steam operated, as we would expect, the total heating surface provided being a little over 17,000 sq. ft. The boiler equipment consists of two Babcock & Wilcox water tube boilers of 170 horse-power each, supplied by C. C. Moore & Co., of San Francisco, and six return tubular boilers of about 135 horse-power each. Two of the latter have been removed, their place being taken by two new boilers 84 in. diameter x 16 ft. long, supplied by Ross & Howard of Vancouver. Fig 1 shows these boilers, the photo being taken before the building was completed. The water tank in the back ground is for supplying the steam locomotives operating on the Company's private railroad. The working pressure is 100 lbs. per sq. in. although the water tube units are built for a pressure of 160 lbs. per sq. in. The boilers are arranged in pairs in the usual brick settings, cast iron full fronts being provided for the return tube boilers. The stacks of these boilers are carried on the centre wall, the breeching being strengthened to transmit the load.

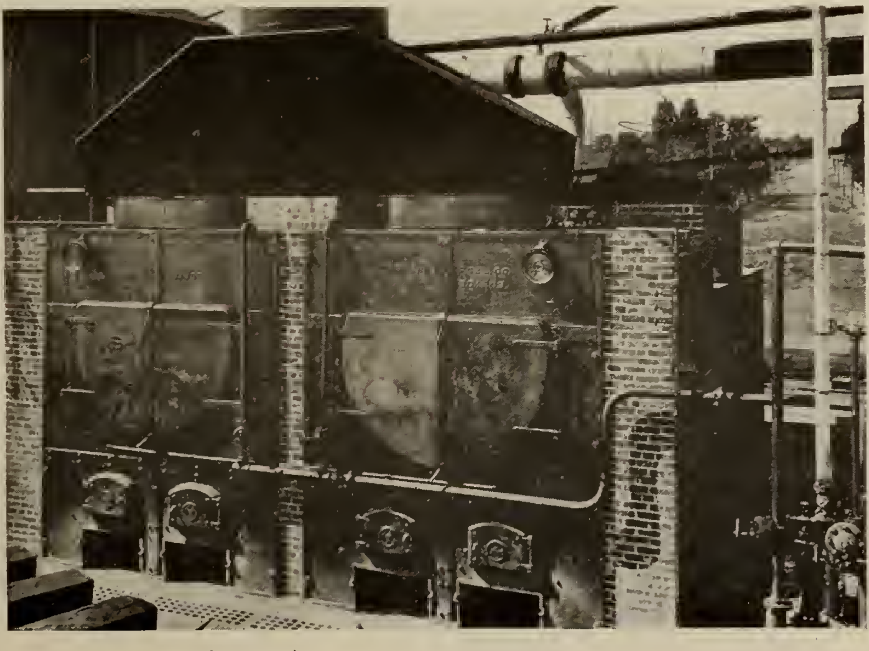

FIG. 1. PART OF THE BOILER INSTALLATION.

Fuel Feature

Strange as it may seem, fuel is quite a problem at a coal mine. Large quantities of sludge, that is, fine coal, are produced, which, if piled on a dump, or used to ballast track would be very liable to spontaneous combustion. The natural method of disposal is to burn the sludge under the boilers. Being very fine, it has to be lightly fired and well spread, three or four shovels full every two or three minutes being the usual routine and resulting in a very hot fire. A large amount of clinker is formed, due to the rock dust in the sludge; fires, as a consequence, have to be cleaned every two hours.

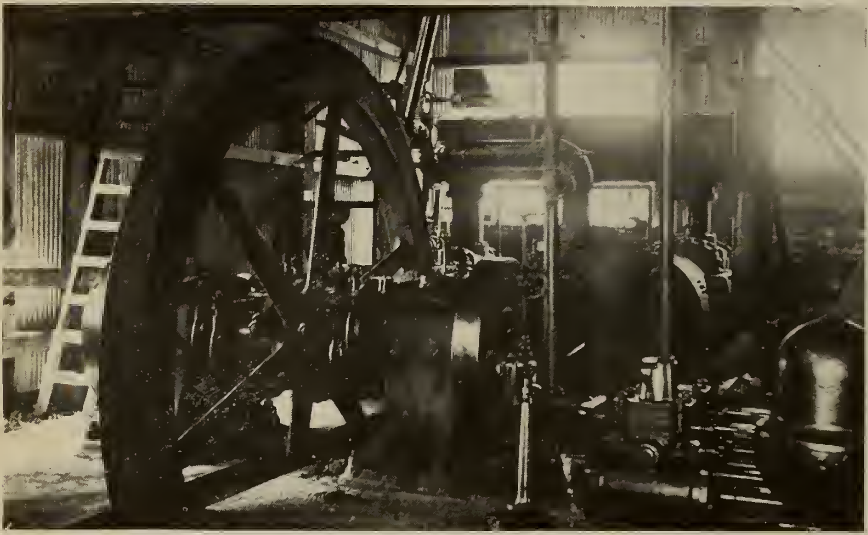

FIG. 3. TWO-STAGE AIR COMPRESSOR DRIVEN BY COMPOUND STEAM ENGINE.

Cleaning fires so often is exceedingly hard work on the firemen and in order to reduce the amount of radiated heat a water service pipe, shown in Fig. 1, is provided. Valves are located above each fire door, and while a fire is being cleaned a copious stream of water pours down in front of it, making a very efficient shield for the fireman. The water also cools the ashes and clinker and as it strikes the latter while white hot makes it much more easily broken up.

Ash and Clinker Removal

The large amount of ashes and clinker formed are removed by a stream of water running in a concrete trough under the cast iron grating shown in Fig. 1. This convenient and economical method of ash removal is extended round the back of the boilers, and whenever necessary the combustion chambers are washed out into it. The concrete gutter and a hose save many hours of hard, dirty labor. The amount of water required for the above luxury is of course considerable, but, as large quantities of water have, in any case, to be pumped out of the mine, this same water is made do something in return for its elevation.

The boilers are operated under natural draft produced by steel stacks 5 ft. in diameter by 100 ft. high. Each pair of return tube boilers has a common stack, while the Babcock & Wilcox boilers have independent stacks. These are the two stacks which show in Fig. 4. on the right. Distribution of steam from the boilers is carried out by means of a 12 in. steel pipe header running the full length of the power house. The header is connected to the boiler stop valves by branches provided with long bends to allow for expansion. A branch from the header is taken underground to the two "Prescott" compound duplex pumps, these units being part of the equipment to keep the mine dry. The pump discharge is a 10-in. column leading up the shaft.

Boiler Feed, etc.

The boiler feed water is obtained from the Western Fuel Co. private water supply system. It is fed to the boilers by two 10 in x 8 in x 21 in Weir vertical direct acting feed pumps, supplied by Peacock Bros., Montreal. An open feed water heater designed by the chief engineer and built at the company's shops, is provided; in it the feed is heated to about 190 deg. F. by means of exhaust steam. The feed water header is carried along the front of the boilers, with branch pipes leading to the check valves on top of same. Valves in the branches, within easy reach of the floor make for convenient regulation of the feed. Internal feed pipes are provided distributing the water just below the water line at each side of the boilers.

Engines and Generators

Electric light and power are used to a considerable extent, both above and below ground. The underground load is about 700 amps., and is principally absorbed by the electric locomotives, used for haulage. The juice is generated by a Canadian General Electric Co., d.c. generator giving 800 amps. at 275 volts. It is direct connected to a 22 in x 24 in. Robb-Armstrong positive type Corliss valve engine running at 150 r.p.m. Speed

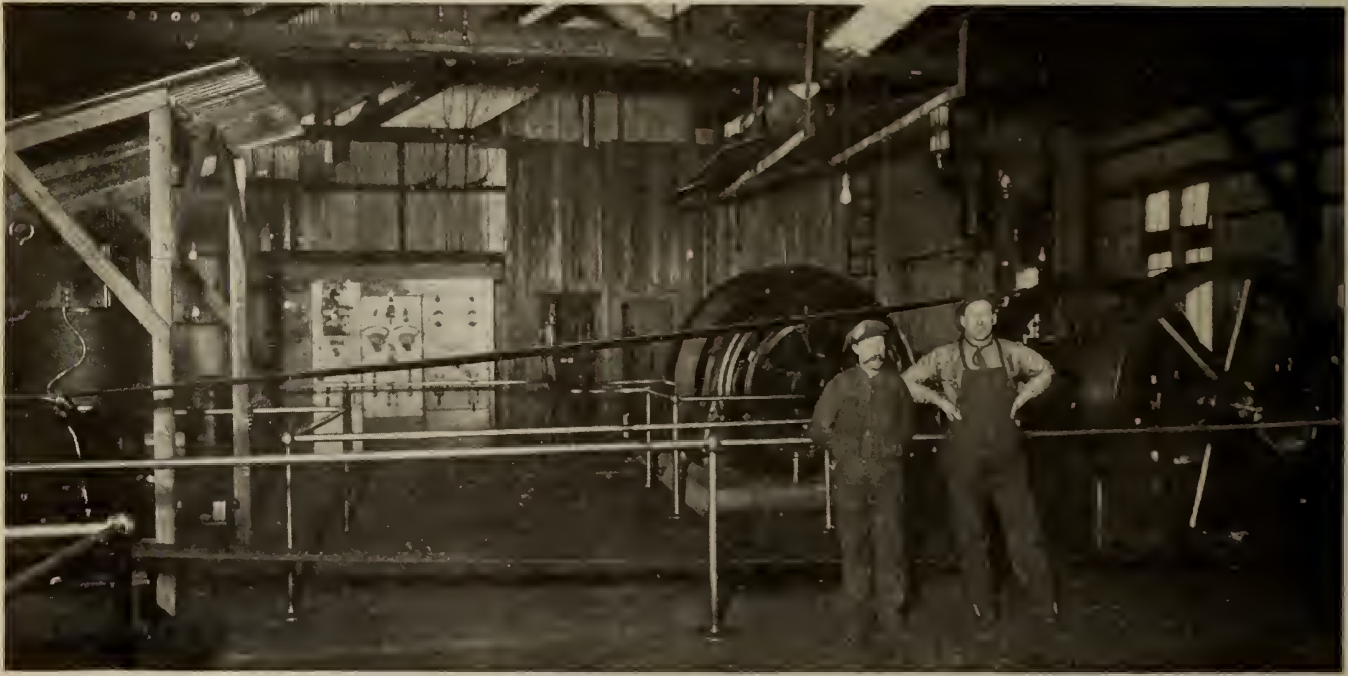

FIG. 2. ELECTRIC LIGHT AND POWER GENERATING EQUIPMENT.

regulation is provided by a Sweet fly wheel governor. Fig. 2 shows this generator to the right in the background. A steam separator, ensuring a supply of dry steam to the cylinder, is provided just above the stop valve. For cylinder lubrication a Richardson automatic sight feed lubricator is provided. Journal lubrication is cared for by sight feed oil cups. The engine and generator are mounted on a heavy concrete foundation and form about the "sweetest" running set the writer has yet come across. The engine on the right foreground of Fig. 2 is a product of the Ball Engine Co., Erie, Pa It is bolted to the 75 k.w. Edison generator, seen on the right. The belt is 14 in. k.w. 2-ply leather. This generator, together with another of similar size, is an old timer, and was part of the original plant. They are both used as stand-bys and for taking the lighting load at nights.

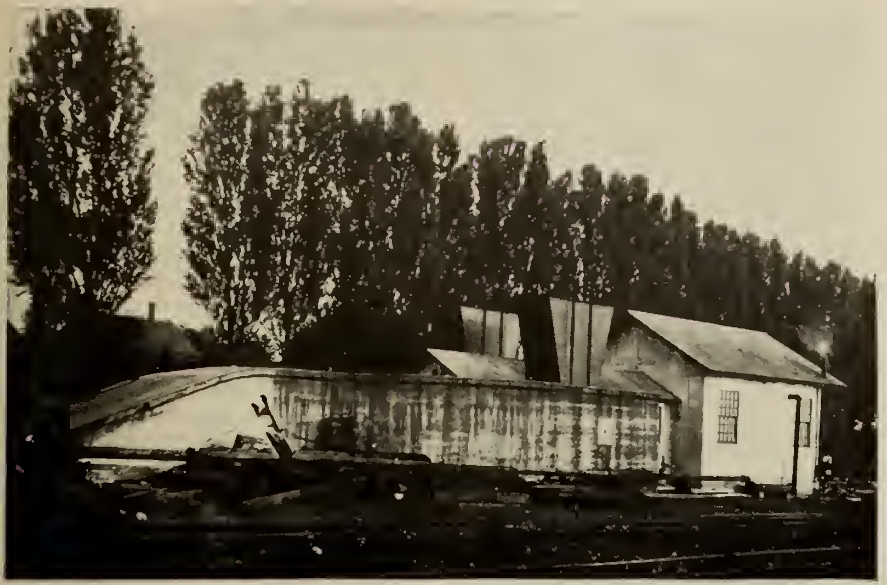

FIG. 5. VENTILATING FAN HOUSE AND AIR TUNNEL.

A four panel marble switch board, supplied by the Canadian General Electric Co. is installed. There is a panel for each generator and one panel for distribution. The panels are equipped with astatic volt and ammeters; automatic overload circuit breakers are provided to protect the generators.

Air Compressor Equipment

In mining work, compressed air plays an important part. At Nanaimo it is used for operating coal cutting machines, driving pumps and also for the operation of a main and tail rope haulage system. There are two Canadian Ingersoll-Rand two stage compressors provided, each being driven by compound steam engines. The steam cylinders are 20 in and 36 in diameter, while the air cylinders are 20 in and 32 in. the common stroke being 30 in. One of the sets is shown in Fig. 3. The air cylinders are directly behind the steam cylinders and are operated by extensions of the piston rods. The steam end is provided with "Meyer" variable expansion valves, giving a wide range of economical operation. Manzel force feed oil pumps, supplied by Bayfield & Archibald of Vancouver are used to supply oil to the steam cylinders. The flywheel on the crank shaft is of cast iron, made in halves and bolted together at the hub and the rim. The L.P. side of the compressor is provided with automatic inlet valves, while on the H.P. side, the valves are mechanically operated by an eccentric on the crank shaft.

A large riveted steel shell intercooler is provided between the two stages, to

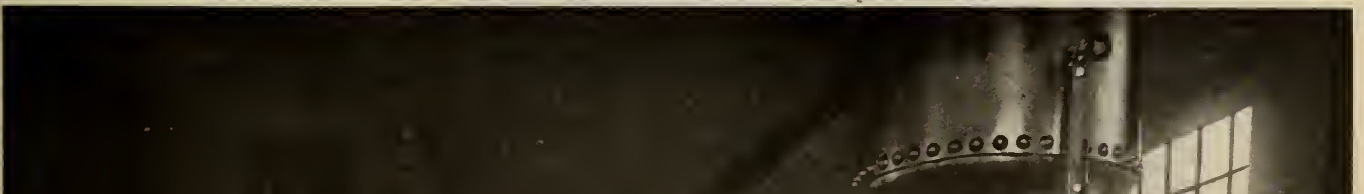

FIG. 6 SINGLE CYLINDER ENGINE WITH ROPE DRIVE TO FAN.

reduce the temperature after the first compression and allow a greater volume of air to enter the H.P. cylinder. The intercooler can be seen in the back ground of Fig. 3. Speed and air pressure regulation is taken care of by an 'Erie'' combined speed and pressure governor. It is operated by a belt from the crank shaft and also by a connection from the H.P. air cylinder discharge. The capacity of each compressor is 2400 cu. ft. of free air per minute.

Hoisting Equipment

The main hoisting engine is located in an independent house with nothing to detract the operator's attention from the hoisting signals. The engine is a two cylinder machine built by Oliver & Co., Chesterfield, England, having cylinders 30 in. diameter by 60 in. stroke. The valves are of the poppet type, being raised by the eccentrics and returned by ball weights attached to the spindles. Manzel force feed oil pumps are provided for cylinder lubrication. The crank shaft is 12 in. diameter and carries a 14 ft. winding drum. The 1½ in. hoisting ropes made by F. & W. Smith, Ltd., Newcastle England, are wound in opposite directions round the drum, thus one cage is being raised while the other is being lowered, and while one is being unloaded at the pit head the other is being loaded down the mine.

FIG. 7. RESCUE SQUAD, NO. 1 MINE.

The hoist is about 690 feet and the time consumed from one hoisting signal to the next is about half a minute. Directly in front of the operator is a dial and pointer, the latter being worm geared to the crank shaft and serving to approximately locate the cages. The exact location is marked on the winding drum, and, in order to bring the cages to the correct positions, the drum must always be stopped at the mark. The title cut shows the pit head with boiler house at right when the cage reaches the pit-head, two empty cars are bunted on to it with a compressed air cylinder, pushing the full cars off ahead of them. As the cars come off the cage they are weighed on a Fairbanks' beam scale, allowance being made for the weight of the car. The net weight is credited to the miner who is identified by a number attached to the car.

Two seams of coal, one suitable for household use and the other for steam purposes, are mined, and, after being weighed, the cars are switched to the proper dump above the screening tables The dumps are of the revolving type and empty the car by turning it completely over. The empty cars are then returned to make another trip down the mine. The screens are perforated to allow the smaller sizes of coal to fall through while the larger sizes pass on to the picking tables, where the rock is picked out by expert pickers standing by the side of the tables.

The smaller sizes are put through a coal washer to separate the rock from the coal which is then screened to separate it into the different small sizes, consisting of nut, pea, and slack. Two washers, the larger of which has a capacity of from 400 to 500 tons per day, are provided. The large washer is driven by a Hamilton engine and is of the ''Robinson'' patent swill tub type, consisting of a tub in which paddles are revolved. The screenings, together with a stream of water, are fed into the centre of the tub and the action of the paddles discharges the coal through an opening in the rim, while the rock, on account of its greater weight, sinks to the bottom, where it is periodically trapped out. Samples of the washed coal and rock refuse are regularly taken, enabling any defects to be detected in an incipient stage and corrected. A Jig washer, driven by a Tangye engine and having capacity of about 240 tons per day, is also in operation.

Mine Ventilating Equipment

One of the absolute necessities of mine operation is ventilation, a stoppage of the ventilating fans, even for a short period, being likely to prove disastrous. At the mine under consideration two fans are provided. They are located in separate isolated houses, and are connected to the shaft by a tunnel. Fig. 5 shows one of the fan houses, the portion of the tunnel above ground being formed in concrete. The air is drawn from the mine up the tunnel and discharged through the tapering steel nozzles shown rising out of the lower part of the fan house roof.

The fans are the Sirocco type, being mounted on the shaft with a solid diaphragm between the two sections. The fan engine shown in Fig. 6 is a Robb-Armstrong Corliss type unit, having a single cylinder of 22 in. diameter by 38 in. stroke. On the crank shaft is an 18-foot grooved driving drum for the rope transmission to the fan shaft. There are eight turns of four-strand 1¾ in. diameter Manila rope, and one turn round a weighted tension pulley. The engine speed is 78 r.p.m., while the fan is speeded up to 260 r.p.m.

On account of the distance from the boilers, a steam separator is provided on the line before it enters the fan house, the separator being kept drained by an automatic steam trap. In addition to this separator, the regular steam dryer, usually installed with this class of engine, is mounted just above the stop valve. Speed regulation is provided by a Sweet flywheel governor, while cylinder lubrication is taken care of by a Richardson automatic lubricator.

As previously mentioned, there is a shaft on Protection Island. The work carried on from that end necessitates a power plant of no mean size. There are installed one Parker water tube boiler and four return tubular boilers for steam generation. Two Canadian Ingersoll-Rand and one Norwalk air compressor supply compressed air to the workings near that shaft. A downcast ventilating fan, similar to those described in connection with the No. 1 shaft, and a hoisting engine, which is used principally for conveying the miners to and from their work, constitute other items of equipment. No coal is hoisted at this shaft except what is necessary for the boilers.

A large and well equipped machine shop is provided, in which practically all the mechanical and electrical repairs are carried out. The shop is on a spur from the company's railroad, rendering the handling of repairs to and from the shaft a very simple matter.

The heating value of the coal mined from the seams reached by these shafts is between 12,000 and 13,000 B.t.u per lb. The output is approximately 1,650 long tons per day. A large portion of the output is exported to Washington and Oregon, also to Alaska. Since 1906 a bunkering business of considerable proportions has been built up. Wharf accommodation for the largest steamers is available close to No. 1 shaft.

For the recovery of the men below in case of accident, the company maintains a rescue squad from among its employees. Complete and up-to-date equipment for such work is kept at hand, and the men maintain efficiency by regular practice. Fig. 7 is a photo of the rescue squad with their equipment.

A. S. Hamilton is master mechanic for the Western Fuel Co., having charge of the mechanical work at all the shafts. No. 1 mine power plant is in charge of R. Martell, chief engineer, by whose courtesy much of the foregoing data was made available.

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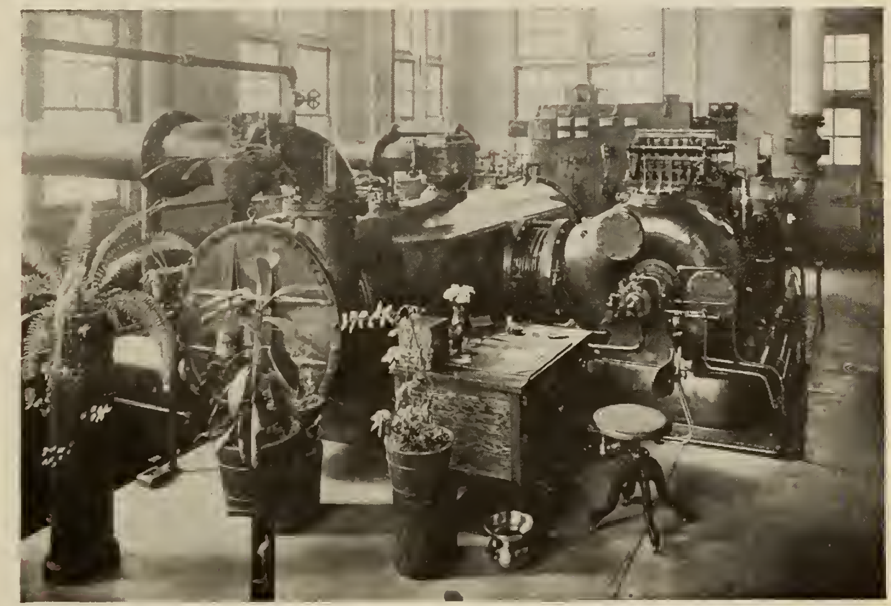
UNITED LAST CO. POWER PLANT

TO meet the requirements of their rapidly increasing business, and at the same time prepare for future needs, the United Last Co. has recently completed the erection of a new factory of the most modern type in the city of Montreal, adjacent to the extensive plant lately constructed by the United Shoe Machinery Co. These two concerns, while operating under separate management, are still indirectly connected, both being managed by the same parent company.

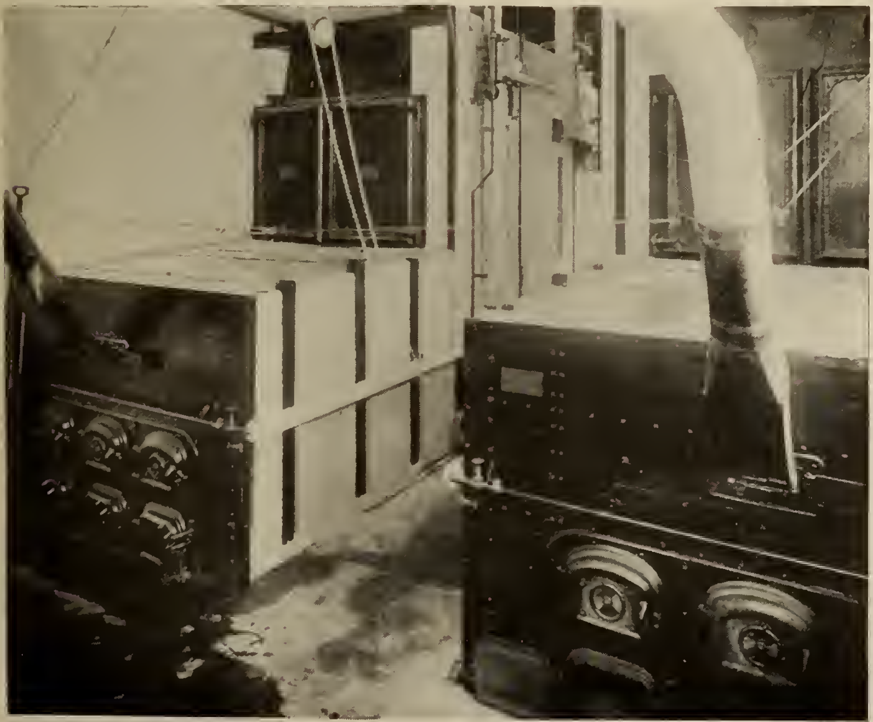
The main building is of mill construction, 140 ft. by 140 ft., one storey high, with basement. The main floor contains the machining department, office and sample room; while the basement contains the supply of rough-shaped blocks, a vault for the storage of standard models, lockers and washrooms, etc.



400 K.W. TURBO-GENERATOR AND CONDENSING PLANT.

Boiler Room

The power house is located at the rear of the main building. An outstanding feature in connection with this plant is the compact yet efficient manner in which the power house equipment is arranged. The boiler house equipment consists of two 250 horse-power water tube boilers, each fitted with Foster superheaters, and two 3-in. Consolidated pop safety valves. The boilers are hand-fired, grates being No. 3 McClare Brooks, 7 ft. by 7 ft. 6 in., 3/8 in. mesh, fitted with twin lever. Thompson damper regulators are also fitted to both boilers. Two 7½ in. by 4½ in. by 10 in. duplex piston pattern, feed water pumps, bronze fitted, of Worthington make, supply water to a Blake Knowles steam stack cut out, water heater. Steel piping, with C. G. E. E. fittings and Lunkenheimer valves are used; steam traps are Anderson low pressure type.



WATER TUBE BOILER INSTALLATION, SHOWING PIPES FOR FEEDING WASTE SHAVINGS INTO FURNACES.

Engine Room

The engine room contains a four-stage condensing Curtis turbine, direct connected to a 600-kilowatt generator, running at a speed of 3,600 revs. per min. This unit is operated in conjunction with an Alberger surface condenser, having a cooling surface of 2,400 sq. ft., equipped with an 8-in. regular volute centrifugal circulating jump, driven by 5 in. x 6 in. vertical Sturtevant engine. There are also one 6 by 14 by 10 in. Alberger horizontal air pump, and one 2 in. Alberger hot well pump. The circulating water is cooled in a large cooling pond, equipped with spraying apparatus installed by the Spray Engineering Co.

The building is equipped with sprinkler system throughout, and in addition, a highly efficient fire-fighting squad has been formed among the workmen. The comfort of the employees is well looked after, individual lockers being supplied, as well as wash basins, shower baths, etc.

Light, Heat and Ventilation

DATA RELATIVE TO HEATING AND HEATING SYSTEMS—IV.*

By T. W. Reynolds.**

IN installations of hot water heating, the pipe should be well reamed out to remove the burr. The effect of burr is to reduce the area of the pipe, decrease the velocity and easy flow of the water. It is the cause of swirling water and eddies and increases the number of points at which sediment may lodge. Long turns should be used in order to avoid abrupt changes in the direction of the water flow. Valves on mains should be avoided, for, should these be closed while the boiler is in service, there would be no outlet for the expanding water. The volume of water increases rapidly as it is heated, and, with the main valve closed and a new fire started under the boiler there would soon be disastrous results.

Turns and angles easily impede the free flow of water in hot water heating systems, such obstructions being more readily overcome in steam installations by the slight pressure usually present. The distance travelled by the water is also more of a hindrance than is the case with the flow of steam for an equal distance. In starting in with cold water in the boiler, circulation is more quickly effected in the hot water system, but the time in which the water reaches a temperature sufficient to be appreciable to the occupants of the building is much longer. It is equally slow in cooling off, which is a disadvantage when comfort and economy are considered. However, the temperature may be steadily maintained due to the amount of heat retained by the large quantity of water in the system. This acts as a reserve or fly wheel to balance fluctuations in the conditions of the fire. Again, the occupants of overheated rooms are inclined to raise the windows for relief from high temperatures, thereby increasing the coal consumption. This is usually the case when the ordinary steam system is employed for heating.

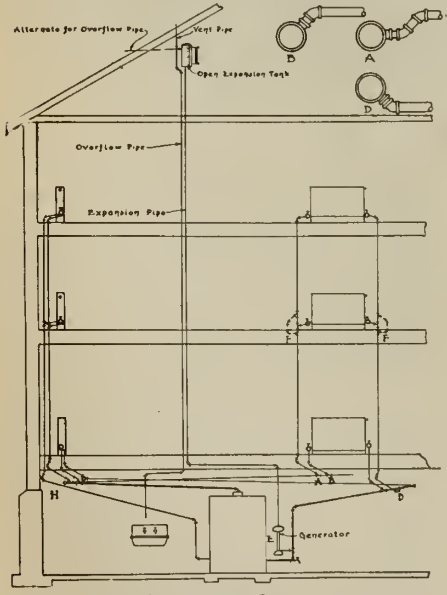


FIG. 7. HOT WATER TWO-PIPE PRESSURE SYSTEM.

Range of Temperatures

With the hot water heating system the possible range of water temperaturtures is considerable and these may easily be varied in accordance with outside temperatures. The amount of radiation to be installed in any system of heating is usually figured to heat the rooms from a temperature of 10 deg. F. outside to 70 deg. F., the desired temperature of the room. When steam heating is used with outside temperatures above 10 deg. F., there is usually no economical means whereby overheating may be avoided. This is controlled in the hot water heating system by varying the water temperatures, but results in a higher relative humidity in the rooms heated.

Even when the rooms are not warmed above 70 deg. F., there is still a more uniform relative humidity in all parts, and this is not so apt to vary in accordance with the distance from the radiators, as in the steam system in which the radiating surfaces have a higher temperature. This higher relative humidity acts favorably on the physical condition of the body. Certain organs of the body will more readily perform their bodily functions to promote our general health and physical comfort.

While the subject of ventilation will not be considered at length here, nevertheless it should be said in passing that proper control of temperature, humidity and air movement are necessary to the success of any ventilation system. Ventilation is generally employed in some form or manner in connection with the majority of heating systems.

Pressure Hot Water Heating

Undoubtedly the simplest pressure type of hot water heating is best represented by the "Honeywell" method. Fig. 7 shows this diagramatically, but there are several specialties, however, in valves, etc., which are not shown. The system is particularly applicable to old and poorly designed installations having undersized pipes in which the circulation is sluggish. The effect is to remedy such conditions by increasing the circulation and water temperature.

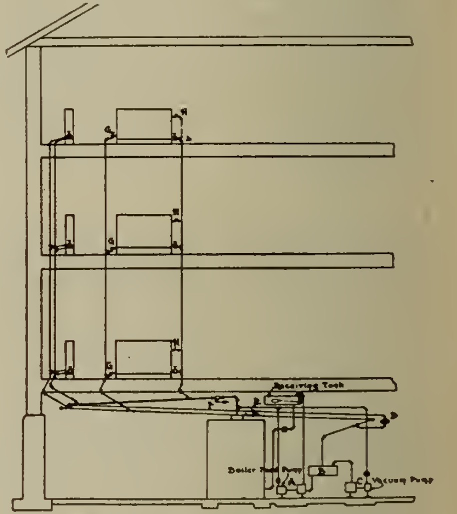


FIG. 8. VACUUM-STEAM MECHANICAL VACUUM SYSTEM, TYPE "A."

As the static pressure increases within any hot water system, the boiling point of the water is raised (roughly to 2¼ deg. F. for each additional pound per sq. in. static pressure at the boiler). In tall buildings, this effect is gained by the natural head or column of water from the boiler to the expansion tank near the roof. For ordinary sized buildings, however, the static pressure does not go much over ten or fifteen pounds per sq. in.

To bring about an additional head of twenty to thirty pounds per sq. in., a device called a "generator" is placed in the expansion line at some point E between the boiler and the expansion tank. This generator is simple in construction.

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*Parts I., II. and III. appeared in our March, April and July issues respectively.

**Of McMullen, Riley & Durley, Toronto.

resembling a barometer with an open top and overflow leading back to the cup of mercury at its base. Before the water can escape from the boiler into the expansion tank it is required to expand sufficiently to raise the column of mercury in the inner tube of the generator.

Velocity of Flow

Not only does this method of increasing the pressure within the hot water system make possible a wider range of temperature within the radiators, but it also has the effect of materially increasing the velocities of the fluid throughout the system when the temperature is increased in the flow pipes. These two factors of the system give it an advantage over the open tank methods of hot water heating in that the radiators need not contain so much heating surface and the cross area of the feed and return pipes need not be so large. The range of temperature with the pressure method of hot water heating is very wide, being from 85 deg. F. to 240 deg. or more. This is favorable when compared with the low pressure steam system, which has a range of 212 deg. F. to 225 deg. F., and with the vacuum or vapor systems, which have a range of 150 deg. F. to 212 deg. F.

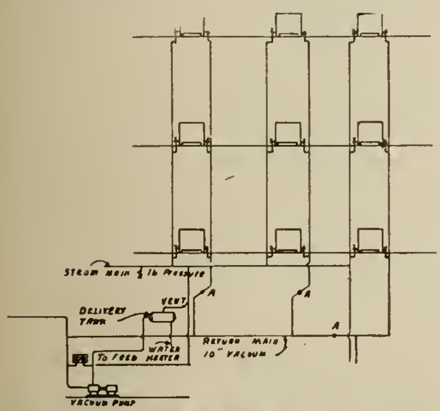


FIG. 9. VACUUM-STEAM MECHANICAL VACUUM SYSTEM, TYPE "A," USING SPECIAL VACUUM CONTROL VALVES.

Most of the schemes for piping in the Honeywell method can be made use of in any hot water installation. The purpose of the schemes used is to properly proportion the system and get a balanced distribution of the heat to all parts of the building. Referring to H (Fig. 7), it will be noted that the first radiator taken off from the main has its return carried back to the boiler independently, otherwise the rapid circulation through this nearest unit would tend to slow up the circulation of the colder water from the units beyond. It is advisable in many cases to carry the returns from the first three or four units, which are supplied back to the heater independent of the main return line. Branches from the mains where reductions are made should be connected for the relief of air through the radiators they serve, otherwise the effective area of the larger pipe would be no greater than that of the smaller. Separate branches to each unit will allow of a better control.

Pipe Size References

* If a 1¼ in. main be used, starting at the boiler, never reduce it, but extend full size to the end. If a 1½ in. main be used from the boiler, it may be reduced one size (to 1¼ in.), but not smaller, and should be extended full size to the heel of the connection leading to the last radiator on the main. It is best, however, to extend a 1½ in. main full size to the end; this will obviate the use of a B connection and separate returns to prevent the possibility of short circuiting.

"Never attempt to connect a one-inch riser extending to a second (or higher) floor to a 1¼ in. main; a 1¼ in. riser to a 1½in. main, nor a 1½ in. riser to a 2 in. main. It cannot be done successfully. The size of the main should always exceed the size of the riser by at least two commercial pipe sizes.

"To secure a high velocity and even distribution of the water throughout the system, mains having a diameter of 1½ in., 2 in., and 2½ in. should not be reduced more than one size after leaving the boiler. Example—A 2½ in. main starting from the boiler should end 2 in. in the last first floor radiator. Neglect of this advice invites all the sluggishness and likelihood of short circuiting."

Hot Water Boiler Ratings

Hot water boiler ratings are usually based on a water temperature of 165 deg. F.; for this reason the boiler selected for a pressure system should have the same capacity as one chosen for an open tank installation, notwithstanding the lesser amount of radiation used in connection with the former system. Steam boiler ratings are generally preferred, as the water must be heated to a higher temperature.

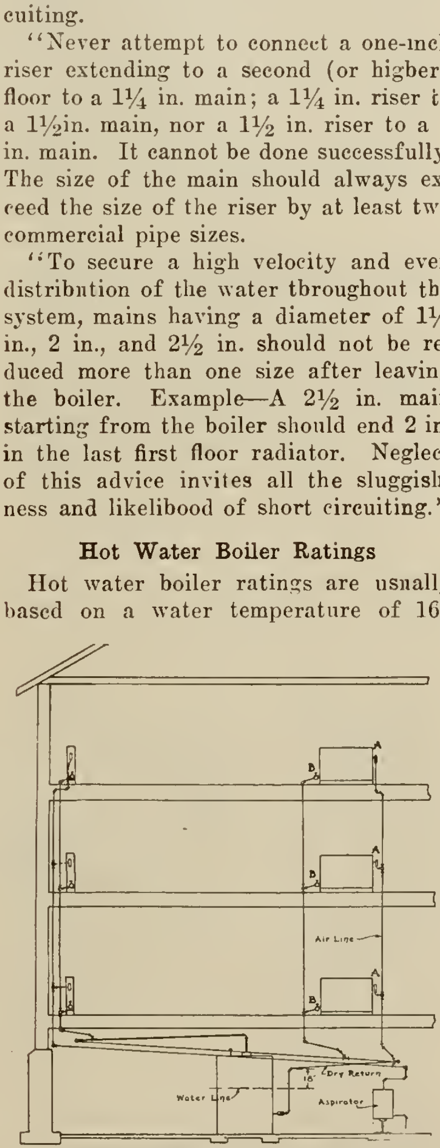


FIG. 10. VACUUM-STEAM MECHANICAL VACUUM SYSTEM, TYPE B.

Vacuum Steam Heating

There are something over seventy-five vacuum or vapor systems on the market at the present time. It is believed that of all these "patented systems," only three general types exist—two of which may be called "Mechanical Vacuum" systems (see Figs 8., 9, and 10), and one of which may be called a "Self-induced Vacuum-vapor" system (see Fig. 11).

The type, a mechanical vacuum system (Fig. 8), is essentially a low pressure two-pipe steam installation, having a vacuum pump C at the end of the return to create and maintain a partial vacuum of 5 or 10 inches on the system, and a pump A to care for the condensation and return it through a receiving tank E to the boiler. In this system, high boiler pressures are required to operate boiler feed and vacuum pumps. Where steam is used only for heating purposes, such pressures may be avoided by using electrically driven pumps.

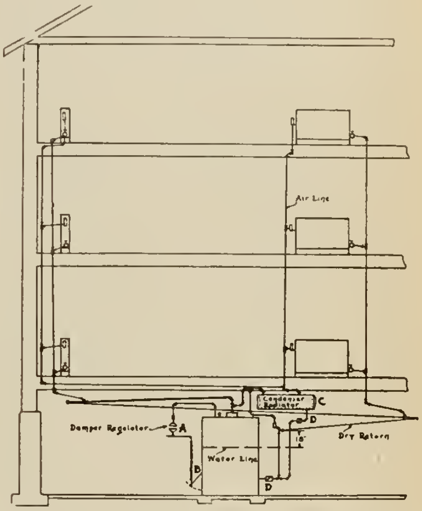


FIG. 11. SELF-INDUCED VACUUM VAPOR SYSTEM.

Medium Pressure Service

It is often desirable to have a medium pressure service boiler, in which case it becomes necessary to place a pressure reducing valve F in the heating main, which reduces the pressure of the steam from the boiler to atmospheric or lower pressure. The supply risers are connected to the radiators with either "thermo-control" valves or ordinary valves of the packless type. Better results are obtained by connecting the steam supply at the top of the radiator, as shown by H (Fig. 8), in which case it is better to use the hot water type of radiator. This allows the modulating valve to be located hand-high.

* * *

It is estimated that 200,000 people from the United States annually visit the Canadian National Exhibition.

CONCERNING LUBRICATING OILS

ONE finds many plants these days buying lubricating oils based on gravity tests, says a writer in the Dodge Idea. The gravity of a lubricating oil is of small value in determining the lubricating value thereof, when considered by itself. It becomes very important, though, in connection with other tests, viz., flash point, burning point, viscosity and cold test, as it enables one to determine with considerable certainty the origin of crude petroleum from which it is produced, also aids in determining the presence of rosin and coal-tar oils, which are objectionable.

Materials selected as lubricants should, in addition to being satisfactory, be uniform in composition, so that they may be used with confidence, and should by all means be neutral chemically. That is to say, they must possess no properties liable to injure metals or other materials with which they come in contact. A good lubricant should adhere tenaciously to metallic surfaces, so that it may not be easily rubbed off.

One of the easiest tests I know of for acidity is to take a small sample of oil, place it in a test tube with a little cupric oxide and subject it to gentle heat for three or four hours. If fatty acid is present the solution will turn green, and if vegetable acid is present it will turn blue. In selecting the samples for trial, the operator or buyer should examine and compare them very carefully in every possible way. He should note their color and transparency, rub some of each between the fingers and thumb or on the palm of the hand, and note if the sample is smooth and oily and contains no grit; pour a few drops on a sheet of tin or piece of glass, holding it at different angles and noting how it flows, also whether it leaves any residue or gum in its tracks; examine it with a strong magnifying glass for foreign substances; smell it, and if it is rancid or has a very offensive odor, reject it.

Some manufacturers buy their oils based solely on color, which indicates the amount of carbon contained in the oil. Free carbon can only be removed, without deteriorating the lubricating properties of the oil, by actual filtration; but an oil should not be questioned simply because of its color. Continued filtration, while improving color, will greatly reduce the viscosity of the oil, hence its lubricating power.

FAILURES OF CRANKSHAFTS IN DIESEL ENGINES.

THAT the engineer in charge is primarily responsible for the lift of the crankshafts of Diesel engines is the opinion expressed in a paper read before the Diesel Engine Users' Association recently.

The paper states that certain reasonable and simple precautions will prolong the period of usefulness indefinitely. A number of failures cited in the paper were attributed to lack of alignment of the main bearings, which generally resulted from unequal wear of the several shaft bearings, although this same result was brought about in some cases by negligence in the erection of the engine, or to defective foundations in some of the older ones.

A four-cylinder engine is most likely to suffer shaft breaks, with the two-cylinder types having heavy fly-wheels, a close second. The shafts almost always fail through the throw arms, the crack starting at the center and working outwards. With the four-cylinder engine, the throw arm nearest the fly-wheel fails in most cases and this is also true of the two-cylinder units. Either throw of the single-cylinder type may fail and with a three-cylinder engine, which is the least likely to be affected, the failures are equally divided between the two end throws.

TUBE FIXING IN WATER-TUBE BOILERS

SOME failures of Stirling water-tube boilers reported upon in two recent British Board of Trade reports, Nos. 2,405 and 2,406, show that the importance of securely fixing the ends of the tubes in the tube plates is perhaps not sufficiently appreciated by makers of this type of steam generator. It is common practice in boilers of the locomotive and Scotch multi-tubular type to fix the tubes by slightly expanding the ends into parallel holes in the tube plates, and when the design is such that the tube plates are held in position by stays or other attachments which make their rigidity independent of the holding power of the tubes, little exception can be taken to this method of fixing, for then, in the event of a tube working loose, nothing beyond leakage can occur. It is seldom of course, that even in these designs the stiffness of the tube plate is entirely independent of the holding power of the tubes, and if this becomes defective over a large area there is risk of the plate being bulged and forced over the tube ends.

In water-tube boilers of the Stirling and similar designs in which the lower drums are suspended from upper steam drums by groups of tubes, there are no stays to connect the drums and nothing to resist the tubes being forced out beyond the holding power of the tubes themselves. In commenting on the case, the chief engineer-surveyor to the Board of Trade calls attention to the excessive stress which tubes in this type of boiler have to bear, owing to the considerable weight suspended from them, and to the importance, therefore, of bell-mouthing the ends of the tubes to diminish the risk of the tubes being forced out of the tube-plate.

Local Overheating of Tubes

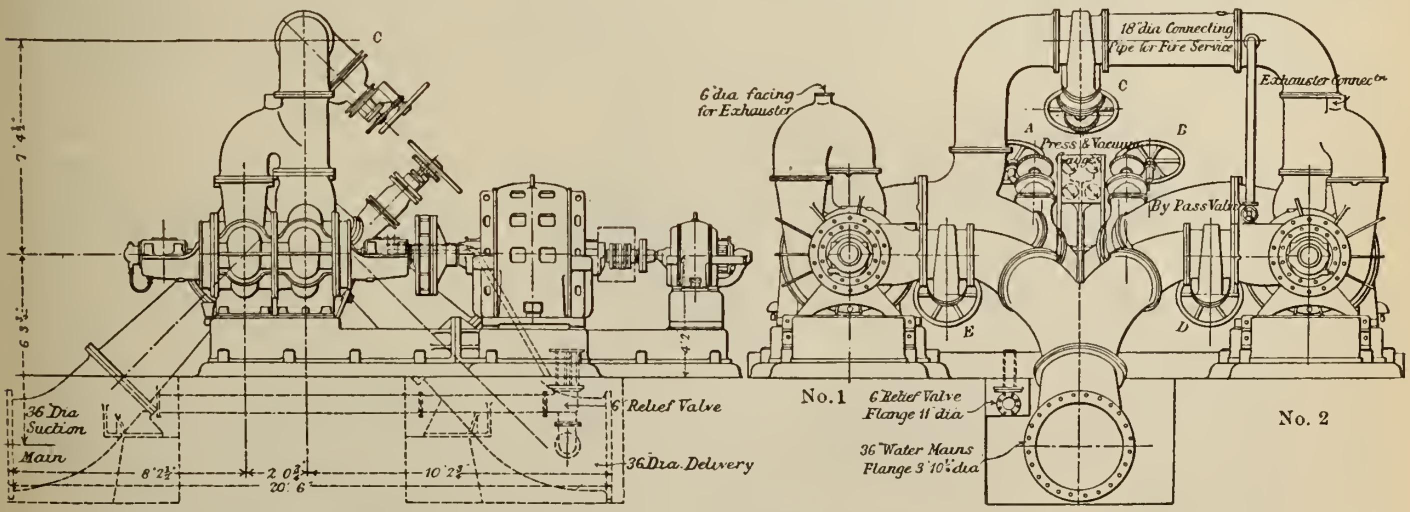
It should be remembered that in boilers of the type under notice the working conditions are rather trying to the tubes. They have not only to carry the load of the lower drums when filled with water, but are directly exposed to the intense heat of the fire and furnace gases which cannot be uniformly distributed, and, therefore, gives rise to racking stresses from differences of expansion. Obviously these are aggravated if the feed water is not good and incrustation accumulates near the tube ends, as local overheating is then set up. This, in fact, proved to be the precipitating cause of three failures in the course of three weeks in the case of one of the reports quoted, viz. No. 2,406, and emphasizes the importance of a water-softening plant in connection with water-tube boilers whenever the feed water produces scale in objectionable quantity. Grease is even more objectionable than scale, as the merest trace with some kind of feed water is sufficient to cause overheating, and, it may be added, is very liable to get introduced where surface condensation is practised unless great care is exercised in the lubrication of the engine and the separation of the oil from the exhaust steam.

HIGH LIFT SAFETY VALVES.

AN opinion prevails that high-lift safety valves produce injurious shocks both to the boiler and valve and the Boiler Code Committee of the American Society of Mechanical Engineers propose to limit the permissible lift. In a paper on the subject submitted to the above society, G. H. Clark alludes to the inadequacy of present day valves to pass off the maximum quantity of steam generated. The discharge capacity of the ordinary valve is limited by both the apparent impossibility of regulation and the shock produced at closing. The pressure below the disc before and during the blowing period is investigated. The action of a valve depends, not on the magnitude of a lifting force, but on variation of lifting force with discharge capacity and pressure. The design of a valve adjustable for variable lifting force is described Six charts show the characteristic actions of different valves. Discharge capacity of valves with diaphrams from 1 in. to 4 in. are tabulated. A valve with the discharge turned downwards, having an upward "jet" action on the disc, is shown and discussed. In determining the rules, valves must be considered on the basis of discharge capacity and action, rather than on the lift.

High Pressure Centrifugal Pumping Plant at Edmonton, Alta.

That centrifugal pumps for both domestic and fire purposes are commanding the attention of Canadian Municipalities when initial establishment, extension or betterment of water supply and service have to be undertaken, is amply borne out by the details of this installation which we reproduce through the courtesy of "Engineering." It may be added that high pressure centrifugal pumping units have been installed on a quite a large scale of late in most of our leading cities, and evidences are that they will continue to grow in favor.



FIGS. 1 AND 2—SIDE AND END ELEVATIONS OF THE PUMPING EQUIPMENT SHOWING PIPING LAYOUT.

As gravitation systems of water supply in many Canadian cities cannot well be adopted under present conditions, recourse is necessarily had to pumping. In numerous instances of late years it has been found advantageous, all things considered, to employ for this purpose centrifugal rather than reciprocating pumps, in spite of the very high thermodynamic and mechanical efficiency of the latter when operating at high lifts. The efficiency feature is, however, generally outweighed by the lower first cost, both direct and indirect, of a centrifugal plant, and its easy maintenance.

Pump Type, Capacity and Drive

This high-lift centrifugal pumping plant was erected at Edmonton, Alta., by Drysdale & Co., Yoker, Glasgow, to the order of R. H. Parsons, Assoc. M. Inst. C.E., at the time in charge of the water and electricity supplies of the city. There are two sets of pumps, each of which is capable of delivering 10 million gallons per 24 hours at a pressure of 110 lbs. per sq. in. Each unit is direct coupled to an auto-synchronous motor of 850 brake horse-power, operating with 2200-volt, three-phase, sixty-cycle alternating current, supplied by the city power plant. The selection of auto-synchronous motors for driving these pumps was decided on because of the great ease of starting as compared with motors of the ordinary synchronous type, and because of the possibility of correcting lagging currents by means of leading current in the motors through suitable adjustment of the exciter current, thus materially benefiting the power factor of the generating station.

Suction and Discharge Mains

The pumps are connected to suction and discharge pipes, each of 36-in. bore, the water dealt with being taken from a pump situated inside the pump-room. This water is first of all lifted from the Saskatchewan River by low-pressure pumps and delivered into a settling pond, thence gravitating through a series of mechanical filters to the sump above mentioned. The discharge main is directly connected to the pipe net-work of the city of Edmonton, which extends on both banks of the Saskatchewan River. Non-return multiple flap-valves are placed in the rising mains, so that, in the event of a shut-down of the pumps from any cause, the contents of the city pipe lines cannot run back.

In order to meet the contingency of a stoppage in the electricity supply, a steam-driven pump is also provided, which can maintain during repairs an emergency supply to the city. Venturi meters are placed in the rising main, so that a record of water used may be obtained, and the economy of the plant checked or corrected. The maximum estimated capacity for a considerable time to come will be under 10 million gallons per day, and thus one unit is sufficient to provide for all requirements.

Control Valves

The grouping of the control-valves is so arranged that there is no cessation in supply when changing over from one pump to the other, and in view of the high pressure prevailing on the delivery side, the sluice-valves are provided with reduction gearing, thus minimizing the labor of the attendant and making quicker manipulation possible when it is desired to change over. Isolating valves are fitted on each of the pump suction branches, thus permitting either unit to be drained out and opened up for inspection ,without disturbing the operation of the other set. The pumps, when run together and connected in series, are capable of developing a pressure of 160 lb. per sq. in. for fire service, and owing to the disposition of valves, very little time is required to bring this increased pressure into use on the rising main. When fire service is called for, one or other of the sets is already running under domestic supply conditions, and therefore, to bring the extra pressure on the mains, it is only necessary to prime the stationary unit from the delivery main, start up the motor and open up the various valves.

It will be observed from the valve arrangements indicated in Fig. 2 that only three stages are utilized for this duty. the delivery from the pump already in service being coupled to the suction of the second stage of the pump, brought in as auxiliary. No flow, therefore, takes place through the first stage of this pump. To protect against overheating of the idle stage, a by-pass is provided which can be opened out after the pumps are on full load. The routine followed in changing over from normal duty to fire service is as follows:—

Normal Duty to Fire Service

Suppose pump No. 1 (Fig. 2) is in service, discharging at a pressure of 110 lb. per sq. in., the water enters through valve E and discharges through valve A. Valve D, on the suction of the other pump is shut, but valves B and C are open, so that pump No. 2 is filled with water at high pressure. To get it in series with the other pump, it is started, and, as soon as it is running at speed, valve A is shut and the full fire pressure of 160 lb. is discharged through valve B. Thus only one valve has to be manipulated. When the fire service is no longer required, the pump giving the extra pressure may be cut out, whereupon the pressure drops to that required by the domestic supply without fluctuation or cessation of flow. The initial priming of the pumps is effected by steam ejectors, there being no foot-valve or other obstruction causing loss of head on the suction main. By adopting this means the danger of water-hammer in the pumps is eliminated. Each pump is coupled to its motor through a shrouded flexible coupling of the belt type, while rigid alignment is secured by mounting pump and motor on a heavy cast-iron bed-plate.

Pump Design and Construction

A section of one of the pumps is shown in Fig. 4, a special feature of the design being the provision made for the ready renewal of all wearing parts. The shaft between the stuffing-boxes is entirely cased in hard-bronze sleeves, while renewable clearance rings are provided at the impeller eyes and peripheries. The centre bearing is of lignum vitæ, housed in an easily removable gun metal shell. The impellers are of tough phosphor-bronze, and designed to give a high efficiency for the conditions prevailing. They are securely fixed to the shaft by feathers, and registered by the shaft-sleeves and lock-nuts; these latter being placed outside the pump-casing, so that their tightness may be verified at any time. There is thus nothing inside the pump-casing on which any fibrous matter entering with the water can be entangled, the rotor presenting everywhere a surface free from projections.

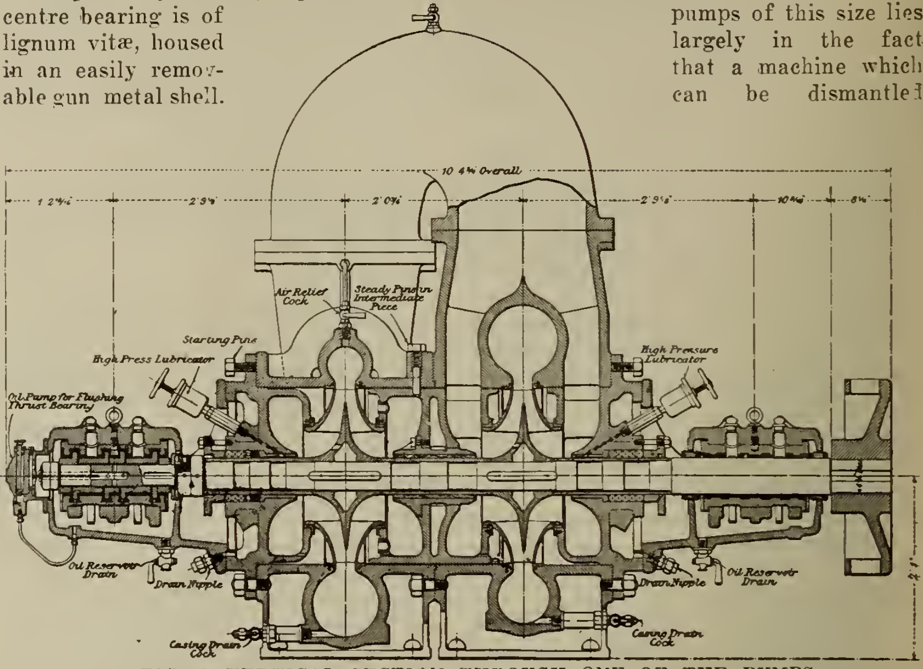


FIG. 4—VERTICAL SECTION THROUGH ONE OF THE PUMPS.

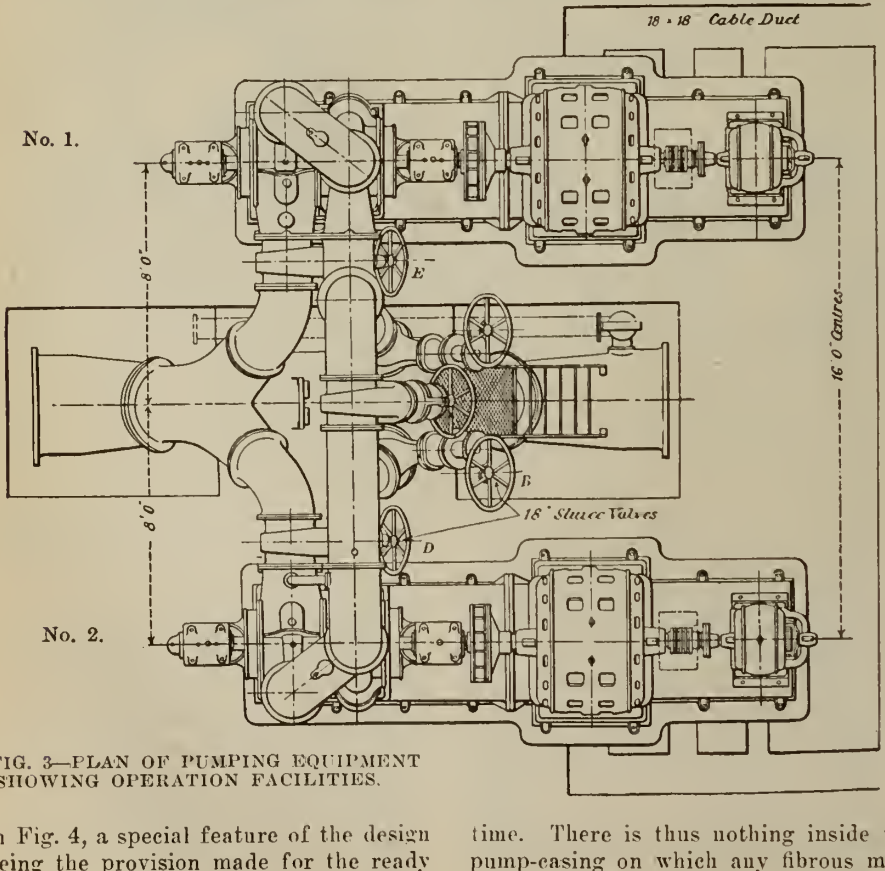


FIG. 3—PLAN OF PUMPING EQUIPMENT SHOWING OPERATION FACILITIES.

Accessibility for Overhaul

The importance of accessibility in pumps of this size lies largely in the fact that a machine which can be dismantled easily generally receives greater care and more frequent inspection than would be the case if examination of the interior or withdrawal of parts entailed removal of pipes, valves, or other heavy castings. In these pumps the removal of the outer end cover with its bearings exposes the first-stage impeller. When this is withdrawn, the intermediate piece can be removed, and it may be noted that a special non-rusting liner and the provision of bushed plugs for the insertion of drawing bolts ensure that there will be no difficulty in doing so. All bearings for both motors and pumps are of the oil-ring lubricated type, thus giving a minimum outlay on oil; and the complete bushes can, moreover, be removed without disturbing the shafting. A multiple collar-thrust bearing is embodied in the outer pump-bearing, and shown to the left of Fig. 4. This bearing is lubricated by oil passing through a central hole in the shaft, whence it is distributed by centrifugal action.

Guide Vanes Eliminated

It will be observed from Fig. 4 that there are no guide-vanes in these pumps, it being claimed by the makers that with the special proportions of volutes and impellers adopted the efficiency obtained is equal to that of the best turbine (or guide-vane) pumps, the accessibility greater, and the initial cost and maintenance considerably less. Further, overloads can, it is stated, be taken much more readily than with a turbine pump, and there is not the same danger of breakages due to the passage of solids in the form of loose timber, stray bolts, etc., which can sometimes gain access into even the best protected pipe systems. The castings are of special tough grade cast iron, amply strengthened, and are designed to withstand a test pressure of 350 lb. per sq. in. Particular attention has been given to the draining arrangements, so that in the event of severe frost, there is no danger of cavities containing water freezing, and putting excessive strains on the castings.

Driving Motors

As stated previously, the motors driving these pumps are of the auto-synchronous, self-starting type, each rated for a continuous load of 850 brake horse-power, the temperature rise not exceeding 70 deg. Fahr. above the surrounding atmosphere after 24 hours' continuous operation, with a lagging or leading power-factor of 80 per cent. This can be adjusted to unity by exciter current regulation, whilst overloads of 50 per cent. can be carried for five minutes without undue heating, and 100 per cent. overload momentarily without injury from mechanical stress, heating, or other causes. The efficiencies guaranteed are 93 per cent. at 25 per cent. overload, 93 per cent. at full load, 92 per cent. at three-quarter load, and 89 per cent. at half load.

This type of motor was adopted by Mr. Parsons owing to the trouble experienced in starting up ordinary synchronous motors on a pump load. Induction motors might have been used, but as the pumps were normally running under much less than full load, the power factor would have been unsatisfactory. The auto-synchronous motors start up like induction motors, and when up to speed the exciter brushes are shifted forward by hand. This raises the exciter volts, and increases the exciter current in the windings until the poles are strong enough to pull themselves into phase. Moreover, by adjusting the exciter brushes backward and forward, a considerable correction for power factor is possible. The machine will pull out of synchronism with an overload, and go back to synchronous speed as soon as it can possibly do so.

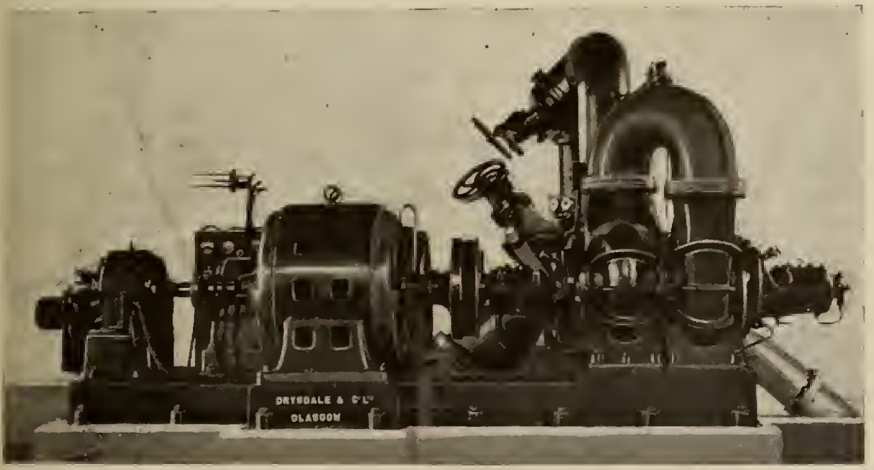


FIG. 5—VIEW OF PUMPING PLANT AS INSTALLED.

Motor Starting

The method of starting is similar to that of a wound rotor induction motor, the speed being brought up to synchronism by the manipulation of an external starting resistance placed alongside the switchboard. On the last step of the rotor resistance unit the machine is running as nearly as possible at synchronous speed, and at the proper moment the field circuit is thrown on by means of a double-pole knife-switch. The exciter voltage is then adjusted by means of the exciter brush gear, and, when the proper value of the exciting current is obtained, the machine drops into synchronism and operates as an ordinary synchronous motor, with the difference, however, that it will not fall out of step and stop should the voltage of the supply circuit drop suddenly, due to short-circuit or excessive overload. In this case the motor will drop out of synchronism, but will continue to run as an ordinary induction motor. When the voltage has recovered, the machine will automatically drop into synchronism, and continue to operate as before.

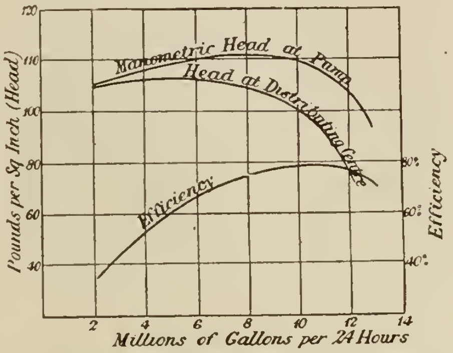


FIG. 6—PERFORMANCE DIAGRAM.

The motor is of the revolving field type, and built throughout for continuous full-load running, both from the electrical and mechanical point of view. All windings consist of former-wound coils, carried in half-closed slots and protected by mica insulation. The stator winding is Y connected, and the neutral point brought out to a terminal. The collector rings are of chilled cast iron, and are provided with multiple copper carbon brushes, the brush rigging being arranged so that one brush can be removed while running, without interfering with the operation of the machine.

Starting Resistance

The starting resistance consists of a number of single-pole switches of the knife-blade type, equipped with interlocking devices so arranged that the operator must cut out each switch in its turn, thus bringing the motor up to speed gradually. These switches are mounted on a rigid steel framework, containing the necessary grid resistances. The whole equipment is of absolutely fireproof construction. The exciter regulator is mounted alongside the starter, so that adjustment of power factor and synchronizing can be carried out with a minimum of effort. The main oil switch and instrument panels are of the Ferranti fireproof mining type, each motor being supplied by a separate feeder from the generating station, so that the risk of breakdown is reduced to a minimum. All mountings necessary for the control and recording of electrical input are supplied, including ammeters, overload relays, no-voltage trips, voltmeters, and watt-hour meters. The general arrangement of the plant as installed is shown in Fig. 5, which we reproduce from a photograph.

Constant Pressure Maintenance

A point of considerable importance in waterworks pumping plant is the maintenance of constant pressure, irrespective of the demand for water. By suitably proportioning the impeller and volute it is possible to give a delivery pressure which rises as the discharge increases, thus compensating for the frictional losses in the rising main and maintaining practically a constant pressure of water at the distributing centre up to and considerably over the normal capacity. These characteristics are embodied in the pumps described above, the general performance at synchronous speed being shown in the diagram, Fig. 6, together with frictional resistances in the pipes and pressure values at distributing centre.

Overloads and Efficiencies

In order to provide against overloads due to a break in the rising main, the design is arranged to give self-regulation in regard to the power absorbed with abnormal discharge, while, in addition, the circuit-breakers on the motor panels are set to cut out at a predetermined overload, so that a "wash-out" is prevented in the event of the delivery main bursting, such an accident being accompanied by a large reduction in pressure and abnormal delivery at the pumping station.

With regard to pump efficiencies, the values obtained on test were 76 per cent. on 25 per cent. overload; 78 per cent. on full duty; 73 per cent. on three-quarter load, and 60 per cent. on half load. It is thus seen that the combined efficiency of the plant from a power point of view, is high throughout the range of duty.

* * *

GAS EXPLOSIONS IN BOILER FUES.

EXPLOSIONS in flues and similar situations are really cases of rapid combustion of gas, says a Vulcan staff writer. Combustible gas may be, in the first instance, kept apart from air, and then supplied through a burner to burn in an atmosphere of air under which conditions the action is under complete control. When, however, the gas and air become intermixed at a temperature too low for ignition,, the resulting mixture is in such a condition that when a light or spark is brought into contact with any part, ignition is produced, which extends through the mass with such rapidity that the audible sensation appears to be instantaneous. The combination of combustible gas with the oxygen of the air is attended with as much heat as would be produced in a jet, but with the same rapidity as the flash, so that the whole mass of gas and air is raised to a high temperature and the explosion produces a corresponding pressure, whereby much damage is caused.

Coal Gas Production

Coal gas—as from the public supply is produced in retorts of various types, which are raised to high temperatures, whereby the gases are driven off. Gas of similar nature is produced in coke ovens or by heating of hydrocarbon oils, or in other ways. In gas producers of various types a limited supply of air is admitted, whereby an appreciable and additional amount of carbonic oxide gas is produced and delivered in mixture with the simple coal gas. The carbonic oxide is also a combustible gas, so that the mixture is equally prone to explosion.

The coal gas which is produced by the irregular action of boiler furnaces is comparable with gas as supplied for illumination and other purposes through the public mains, although the former is more variable in composition, and probably is never free from air. A mixture of one volume of illuminating gas with from two and a half to nineteen volumes of air will explode on the application of a light or a spark to the bottom of the mixture. A mixture of from three and a half to ten volumes of air with one of gas will explode if lighted at the top.

Coal gas is much lighter than air, the specific gravity of pure coal gas, as compared with pure air, being usually from .4 to .5, but may range from 25 to .8. Moreover, the gas as given off by a banked fire is most probably at a temperature distinctly greater than the temperature of the admixed air with which it may be in contact in the fire. The combined effect of these two conditions produces a strong tendency in the gases to pass in a stratum along the upper part of flues and to accumulate in any upward cavity to which it may have access. It is obvious that if the roof of the entire flue should rise continuously from the fire to the chimney without dips, dampers, or other interruptions, there would be opportunity for gases to accumulate, and they would pass off as rapidly as they were produced.

It has been stated that if the combustible gas and the air were kept apart they would be quite under control. This point must, however, not be extended to imply safety in the present connection. Firstly, diffusion of gases must ensue and cause mixture which must, over extensive areas, involve absolute certainty of explosion on the application of a light. Secondly if special conditions were in force to prevent diffusion, and if the boundary were sharply defined with gas above and air below, the liability to explosion would still exist throughout the length and width of the contact surface between gas and air; posslbiy, this particular phase of the question .involves greater danger than any other .

Simple Case of Flue Explosions

The simplest case of flue explosions is found where a very hot fire is loaded with fuel in such a manner as to produce coal gas, which may be given off free from mixture, or with admixture of carbonic oxide, due to the passage of a strictly limited amount of air through the bed of fuel. In either case, up to this point, the gas is practically in a non-explosive condition. This general circumstance is very common in the banking of fires for the night stoppage. If, however, prior to banking, the fire is allowed to burn down without receiving careful attention, it will have become thin in some parts, and probably large sections of the grate will be quite bare. In either case the fire may in such parts fail to possess sufficient vitality to continue alight, so that air is admitted without change through such parts of the grate. Alternatively, the whole grate may carry fire in all degrees of strength, so that strong combustible gas is given off in one part, varying to practically pure air in other parts. Thus the gases as a whole, when mixed together, may be in a highly-explosive condition, and in the course of a night the whole length of flues may be charged with such gases. If a light were applied, or a spark were to reach the mixture, a violent explosion would be inevitable, and this is frequently affected by the action of the stoker in breaking up the fire, which brings incandescent fuel to the surface or allows a stream of incandescent gas to pass along the flues. In many such cases safety can be assured by first opening the dampers and firing doors in the morning and allowing time for the explosive gas to be cleared out up the chimney before the fires are broken up or touched.

It often happens that flues, economiser spaces, etc., become charged with a mixture which contains so much air as to form a strong explosive mixture with coal gas. In such case the result is very similar to that in which the mixture is affected in the furnace, but the damage caused by explosion may be located between the boiler and the chimney. Here again the explosion cannot be started without introducing a medium of high temperature into the explosive mixture of gases. This is most likely to be effected in the furnace—before—and transmitted by a weak mixture of explosive gas to the stronger mixture in the part in which the destructive effects are most clearly manifested.

Attention to Banking of Fires

From the above it follows that the fires should receive careful preparation before banking for lengthy periods. Cleaning or removal of ash should be done a short time previous to shutting-down time, and the fires should be afterwards burnt to a suitable temperature and bulk; then they should be levelled to approximately uniform thickness.

In connection with the banking of fires, the adjustment of the dampers is an operation of some difficulty. It is generally impossible to shut the damper close to the stops, as this would cause the escape of smoke or gases to such an extent a to fill the boiler-house to suffocation. A little further opening of the damper may stop the escape of gases into the house, but may not effect their passage up the chimney; the gases therefore accumulate in the flues, the economiser space, and any other cavities. Opening to an appreciably greater amount involves further difficulties, one of which is is the "burning out" of the fires.

In ordinary cases the difficulties in connection with adjustment of dampers are completely overcome by arranging to shut each damper close to the stops and provide sufficient area for the occasion by boring holes in the damper. Such holes must be placed in the upper part of the damper, so as to pass the light gases, whereas if they were placed at a lower level they might pass stagnant air and omit to pass the combustible gases. The holes should be of 1½ in. to. 2 in. diameter, and sufficiently numerous to suit the case. It is better to drill the holes, one or two at a time, so as to avoid the provision of more holes than necessary. If, however, this is done, the excess holes may be stopped, preferably by the use of screwed plugs. In special cases a supplementary by-pass way be adopted, in principle equivalent to general practice in connection with steam stop valves or gas-supply fittings. The leading point to remember is that the damper may, under all ordinary conditions, be closed against a definite stop.

Other Explosion Sources

It is obvious that explosion may be produced by mixture of air and combustible gases from other sources than the ordinary furnaces of steam boilers.

Explosions have occurred with boilers when hand-fired with wood waste or other bulky material liable to rapid gasification. These explosions are due to the choking of the furnace by a close mass of the fuel, whereby the air is largely excluded from the fire during the period when combustible gas is being distilled, while a moderate amount of air enters at the back end of the grate, or elsewhere, and becomes mixed with the gas. Such a mixture may accumulate until the fire burns through the fuel and effects an explosive ignition. In such a case, the obvious remedy consists in avoiding the choking of the fire, i.e., by feeding in smaller quantities at shorter intervals of time.

Oil Firing Explosions

Many explosions have occurred in connection with oil firing. Practically these are true gas explosions, as liquid fuel is virtually converted into gas before burning. These accidents have principally arisen in one or two ways. Firstly, the oil is turned on and gasified during some appreciable length of time before lighting, so that the furnace is more or less completely filled in the meantime with an explosive mixture of gas, which is fired when the jet is lighted or when it is brought into a full flaming condition. This point may be illustrated in any gas-lighting burner which is enclosed by a lantern, or even by the fittings of an ordinary incandescent burner. If a lighted taper is held to the burner, and the gas is afterwards turned on, the gas is lighted in silence. If, on the other hand, the gas is first turned on and allowed to accumulate in the casing, and the taper applied only a few seconds later, the gas will ignite with explosive violence. In the second division some part of the oil escapes the gasification process by reason of some defect in the burner, while the flame is burning more or less imperfectly and the mixture is fired when the temperature of the flame is increased.

Explosions have occurred in connection with the crank chambers of high-speed engines in which the crank pins are lubricated by spoon. The agitation of the oil raises a kind of oil-mist which is easily ignited by a lamp inadvertently inserted for examniation of bearings, etc. Obviously, the formation of oil-mist in this way is promoted by the heat from a defective bearing.

Coal Dust Explosions

Many explosions in flues have been caused by coal dust. Principally these have arisen in connection with the adoption of dust firing of boilers and particularly by opening the fuel valve without ensuring that the jet of dust should be simultaneously lighted as already explained in connection with the starting of gaseous or liquid fuel jets. It is, however, quite possible that dust explosions may occasionally arise in connection with the flues of coal-fired boilers; perhaps the most likely manner would be in breaking up a fire which has been banked with dusty fuel, and in which there is draught power to disperse coal dust equal to half an ounce per cubic feet of space. Accurate proportions to obtain perfect combustion are about 1 lb. of good, fine coal dust to 133 cubic feet of air, or, say, one-eighth part of an ounce per cubic foot of air.

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ELECTRIC LIFT SUPERVISION AND MAINTENANCE.

THE duties of a supervising engineer, if he is responsible for the maintenance of a lift are: (1)—To ensure its safety; (2)—To secure efficiency and continuous service; and (3)—To minimise wear and tear. Having satisfied himself as to the constructional safety of the lift, the engineer should turn his attention to the wearing parts. The ropes, in particular, must be kept under regular inspection, and any sign of undue wear of broken strands noted. Should any extension of a damaged place amounting to fraying occur, the ropes should be condemned at once.

Any back-lash in the gear must be enquired into. It may be a loose key in the sheave or worn-wheel which requires reseating, or, possibly, the teeth of the worm-wheel are dangerously worn, in which case the wheel must be replaced. Wheels have been known to be worn to the verge of stripping before the fault was noticed—a very serious state of affairs, and one which is impossible under any system of skilled inspection.

The gear case must be kept charged with oil, which must be changed as soon as it becomes thick or denaturalised. The best lubricant for the purpose is pure castor oil. Whenever internal trouble is noticeable, a dose of castor-oil in the gear-box anywhere from two to 20 gallons, according to circumstances, will be found as effective a remedy for a lift as a somewhat smaller dose is in other cases.

The safety gear must be greased and inspected regularly, and should be put to a practical test, by allowing the car to drop upon it occasionally.

Electrical Contacts and Dashpots

All electrical contacts must be kept scrupulously clean and carefully adjusted. A supply of spare contacts should always be available with which to effect prompt replacements.

Air dashpots require occasional adjustment to maintain correct acceleration. From time to time the leather should be applied with a little oil. The air escape vent must be kept clear of any grit which may get in from time to time, and to block the passage.

Oil dashpots are not altogether a success. However well they are designed, a certain amount of oil sprays out, and, settling upon the controller parts, ruins the insulation. Where they are found, great care must be taken to keep them clean and avoid troubles from this cause.

Dismantling the Motor

Should it be necessary to dismantle the motor, the greatest care should be taken to check the connections on reassembling, to ensure that the compound field windings are acting together. If by any chance they be connected up in opposition, the fault may not be observed at first, and so long as the shunt field has control, the lift will continue to travel as before, but rather faster. Under these conditions, an increase in the load will cause the series current to rise rapidly; the motor will reverse, and, running with a very weak field, will precipitate the car at terrific speed upon the buffers, The strange thing about such accidents is that they are always brought about by men who know their business so perfectly that they do not think it necessary to check their connections over before putting the machine to work.

Electricity and Hydraulics

POWER FROM OCEAN TIDES

By A. J. Campbell.

FOR centuries it has been recognized that the millions of tons of water in motion through the ebb and flow of the tides would, if properly harnessed, give sufficient power to operate machinery installed the world over. The extraordinary tides of the Bay of Fundy have long beckoned to inventive genius. It has been generally recognized among engineers who have given thought to the subject that if at any point tide power is possible, the Bay of Fundy shore possesses distinct advantages as a site for experiment.

Bay of Fundy Adaptation

The Bay of Fundy is an arm of the Atlantic Ocean, separating Nova Scotia and New Brunswick. Its average width is about thirty-five miles. At the head it is divided into two branches by Cape Chignecto. The average speed of the tide in the bay is from one to two knots per hour, but in some places this speed is considerably exceeded. At some seasons the tide rises to a height of fifty-three feet. The swiftest tides, although not the highest, are at Cape Split, between Minas Channel and Minas Basin, where the usual maximum rate is from seven to ten knots and often more. Here a promontory rises abruptly from the water 335 feet above mean high tide level. The accompanying photographs give an idea of this location. It is at this point that preparations are under way to develop Hydro-Electric power from the tidal current. Briefly stated, the proposal is to place current motors in the tidal stream and operate pumps by means of their power, the pumps delivering water to storage reservoirs on a neighboring hill. From the reservoirs the water will flow as regularly as required to water turbines in a power house at the foot of the hill, these turbines driving electric generators.

Tidal Power Projects Elsewhere

In previous attempts made elsewhere to utilize tidal power large dams have been constructed. These dams enclosed reservoirs, which were filled by the incoming tide and emptied through the power gate between them, one reservoir being kept at high tide level and the other at low tide level. This method could not be satisfactory for continuous power unless the reservoirs were very large to prevent loss of head between tides, and the dams correspondingly large and expensive. In most cases such dams would interfere with navigation unless provision were made for lock canals. Moreover, the intermittent service makes some form of storage absolutely necessary. This, of course, requires large areas, expensive dams and similar structures.

Tide Motor Idleness

Any tide motor is necessarily idle at four periods in twenty-five, viz., at high and low water slacks. In consequence, some provision must be made to carry on the work during these periods. Electric storage batteries would be impracticable owing to the expense of installation and upkeep. An auxiliary steam plant for use at these periods would have to be sufficiently large to operate the machinery for the greatest need, because of the continually changing time of day when slack water occurs. That

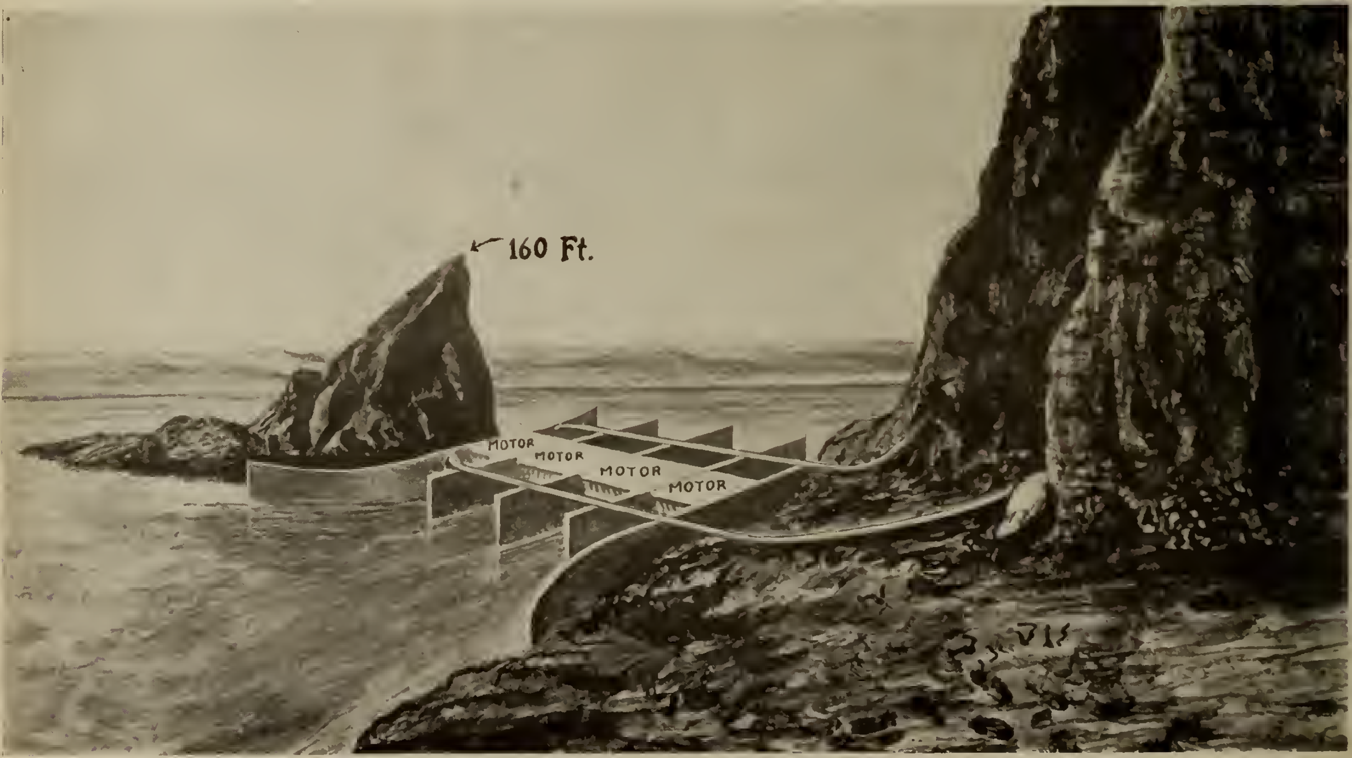


FIG. 1—SHOWING PROPOSED PUMPING PLANT INSTALLATION IN NATURAL TIDE RACE.

being so, the steam plant might as well be operated continually, as the additional cost of operating for the remainder of the time would not likely be as much as the interest on the entire installation.

Not only is the flow entirely stopped at four periods in twenty-four hours, but the tidal height between these periods is constantly changing to a marked degree, and it would be difficult to adjust any machinery depending on tidal height or head unless it were adjusted to the lowest efficiency. Even then the power output would be a continually varying quantity. The fact that in most localities the tidal rise is very low makes any development dependent upon head costly, for the first cost of a low-head plant is always unusually great. In addition to other difficulties, a tide water like the Bay of Fundy must be free for navigation. An opening like Digby Gut might conceivably be dammed and a water power installed, were it not for the fact that navigation must not be interrupted. A power plant then for even a favorable tide like the Bay of Fundy must be so adjusted as to give continuous, regular and sufficient power with comparatively low cost of installation and operation, and at the same time must not interfere with shipping.

Proposed Location

The promoters of the scheme under discussion searched for a location possessing three requisite advantages—a swift current for a considerable portion of the day; high land nearby with an area sufficient for storage reservoirs; a suitable location for the power house. These requirements they found at Cape Split. This location has the longest continued swift currents of any place in the Bay—that is to say, the average speed of the current throughout the whole twenty-four hours is the greatest in Fundy Bay, and as great as any location in the world of which we have definite knowledge. The cliff rises from 335 to 400 feet above mean high tide, making necessary the handling of only relatively small amounts of water, thus reducing the size and cost of the reservoirs. The high head also makes all the power house machinery costs small in comparison with similar machinery for low heads.

Transmission Feature

The situation is very favorable for the transmission and distribution of power, while there is unlimited opportunity for the expansion of the plant as business warrants it. There is, besides, no interference with navigation. The plan for utilizing the energy of the tides at Cape Split involves no freak tidal motor nor any motor operated by the rise and fall of the tides. All the machinery to be used is based on well-known principles of operation, and most of it is of the usual type and of the usual sizes employed in connection with municipal waterworks and hydro-electric generating stations.

It is proposed to instal Clarkson current motors in channels located in the natural tide race at the Cape (Fig. 1), where the speed of the current exceeds that of our swiftest streams, and, so far as known, is not equalled by tidal currents anywhere on earth. These current motors of new and efficient design will operate pumps located in pump chambers in the channel walls, and elevate water to small regulating reservoirs placed on the adjacent high cliffs more than 300 feet above mean tide level. From the reservoirs or forebays the water will run by gravity through concrete penstocks to the turbines in the power house. The latter will be located at sea level near the foot of the cliff, on the Minas Basin side of the Cape. These turbines will drive alternating current generators, which will deliver electrical energy to high tension transformers, from which the transmission lines will be supplied. It should be noted that the proposed method for use at Cape Split is not a general method of utilizing the power of the tides. It is made feasibly practicable, and at comparatively low cost there solely because of the unique combination of natural conditions.

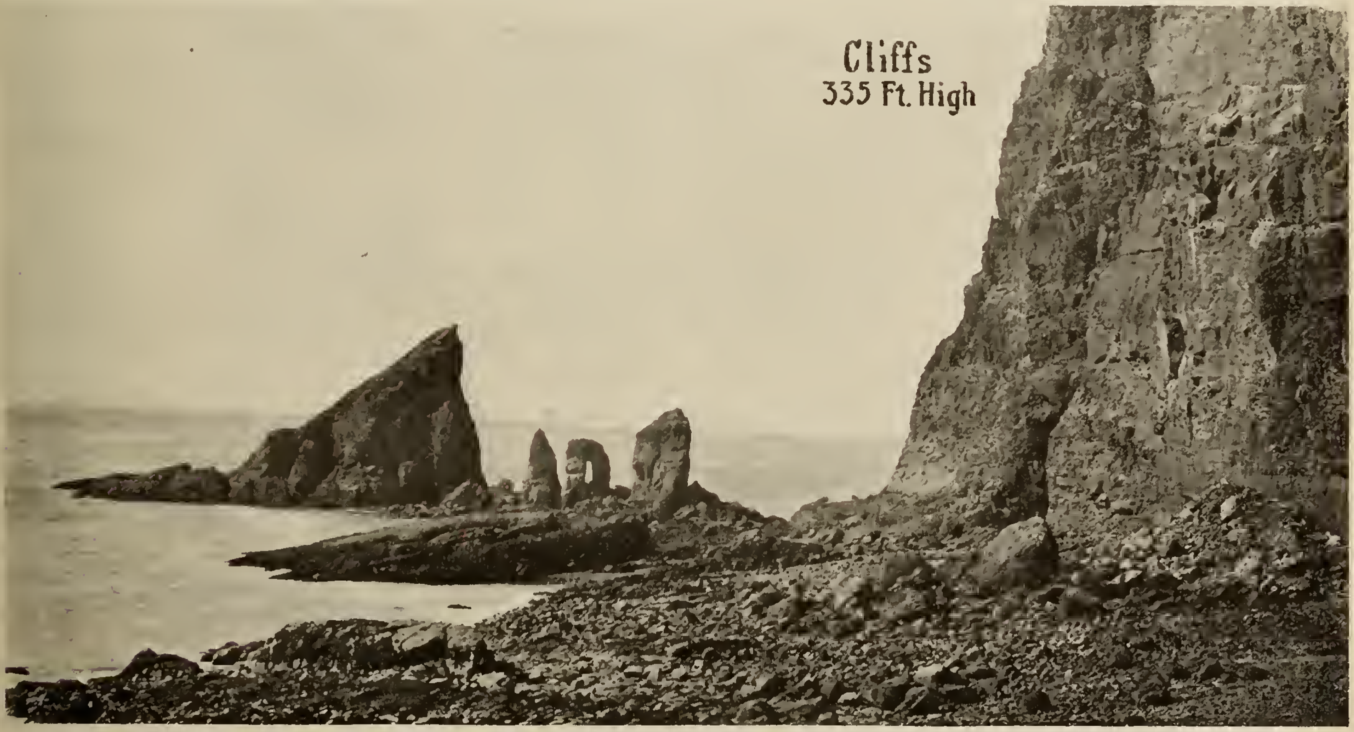


FIG. 2—SHOWING THE NATURAL CHANNEL BARE AT LOW TIDE.

Tidal vs. Interior Water Power

There has been little necessity for tidal development in America, as capital has been largely directed toward undeveloped interior water courses which are widely distributed. The methods of utilizing these have been carefully worked out. In considering this phase of the question, however, it is important to note that the Commission of Conservation (1910) estimated the possible development of water power for Nova Scotia to be only 54.000 horse-power, much of which would not be available for a portion of the summer unless extensive storage could be provided. This is not sufficient to carry the total installation of steam and water power of Nova Scotia alone (49,724 h.p.) throughout the whole year, and leaves no room for future development if water power were the only power used. If hydro-electric power comes into general use in Nova Scotia it must be through the utilization of tidal power.

Market for Tidal Power

Industries in the Maritime Provinces within reach of a Hydro-Electric plant at Cape Split require 85,000 horse-power, and are producing this at high cost from coal. Indeed, all the industrial centres of the Maritimes are available for electric transmission from this point, with the exception of those in Cape Breton Island, and even they are not beyond the electrical transmission distances in vogue in Ontario and elsewhere. The manufacturing plants of Halifax, Windsor, Springhill, Amherst, Sackville, New Glasgow, Moncton, Sussex, Truro and St. John are within easy transmission distance.

A population of one million lives within a radius of 125 miles of Cape Split. The two proposed transmission lines with their branches touch towns within less than 100 miles, having a combined population greater than that of any city in the Dominion except Montreal. The whole territory covered by the lines possesses a larger population than either Montreal or Boston, and exceeds the combined population of Toronto, Ottawa, Quebec, Winnipeg and Vancouver. While a large proportion of this population is rural, there is a very apparent tendency toward community gathering, and this tendency would, of course, be promoted by any general distribution of cheap power.

A suggested new outlet for power is a trolley line from Windsor to Annapolis. Such a line would pass within fifteen miles of Cape Split, and would follow the transmission line toward Halifax for twenty-five miles. The projected road would traverse a most prosperous farming district, not a little of which is poorly served by railroads, and would open up a passenger and freight traffic which should be profitable. There is also the ever-present possibility and desirability of electrifying any or all of the steam railroads at present established, particularly if the work of double-tracking the roads should begin.

Holding Company Formed

A holding company has been formed and the necessary funds have been subscribed to demonstrate exhaustively the practicability and the reliability of the project. This company is known as the Cape Split Development Co. The president is George B. Cutten, president of Acadia University, Wolfville, and the managing director is R. P. Clarkson, Professor of Engineering at Acadia. These gentlemen are firmly convinced that the problem of harnessing the Bay of Fundy tides has been solved, and that they have hit upon the means whereby cheap power in abundance is obtainable for the Maritime Provinces.

Preliminary work on the Hydro-Electric project has been already carried out, the necessary lands have been acquired, and the patent rights secured to the current motor to be used. A charter has been granted to Bay of Fundy Tide Power, Ltd., with wide scope as a public service corporation for the construction and operation of a hydro-electric plant at Cape Split. The control of this will be vested in the Cape Split Development Co.

HYDRO-RADIAL PLANS APPROVED

THE plans evolved by the Hydro-Electric Commission of Ontario for serving the district lying between Toronto and Niagara Falls with radial railway lines were approved on September 1, at a convention of the greater Hamilton Hydro-Radial Union, which was attended by seventy-five delegates, representing the various municipalities interested.

Chief Engineer Gaby outlined the route of the proposed line from Toronto to St. Catharines via Hamilton. He said that the station in Toronto would be at the foot of Yonge Street, where a terminal at a cost of $1,000,000 would be erected. The ultimate cost of freight and passenger terminals in Toronto was estimated at between $6,000,000 and $7,-000. The lines will run south of the steam lines to Port Credit and thence to Clarkson and through the centre of Oakville, thence south of the Grand Trunk and parallel to the Hamilton Radial Railway to the centre of Burlington. Two surveys have been made from there, he said, one north and one south of the Plains Road. The line will cross the Grand Trunk overhead and will proceed along to Harvey and Dundurn Parks in Hamilton.

Passing along a route formerly suggested by the late John Patterson and the C.N.R., it proceeds along the north of the Grand Trunk Railway, through a portion of the city, and then crosses over the G.T.R. overhead at a point near John Street; hence it goes on to Stoney Creek, Winona, Vineland, Grimsby, Beamsville and St. Catherines. The line will be substantially built and equipped for freight and high speed traffic. In Hamilton as far as Keith Street there will be overhead crossings. The sum of $11,260,363 is the gross estimate for the construction of terminals, sub-stations and shelters for the proposed line from Toronto to St. Catharines. An overhead bridge near the Valley Inn is included in the plans. Facilities will be provided for supplying power along the route and for leaving the line for a distance of perhaps ten miles. In cases where a township has two or three bridges, the expense will be spread over all the districts benefiting by the work.

WILL ENLARGE HYDRO SYSTEM

EXTENSIONS and improvements involving an expenditure of well over a million and a quarter dollars are being undertaken by the Provincial Hydro-Electric Commission to meet the ever-increasing demand for Hydro power. The announcement was made recently by Sir Adam Beck and preliminary work is already under way.

Double Transmission Line

The chief item of new work is the doubling of plant and equipment from Dundas to Toronto. Largely to meet the needs of Toronto the Commission has decided to go ahead with the construction of a new double transmission line between Toronto and Dundas, and practically to duplicate the Toronto station—the expenditure being estimated at something over a million dollars. At Dundas the Commission is also practically duplicating the big inter-switching station there at a cost of approximately $250,000. At Niagara Falls new switches and other equipment to handle the 50,000 additional horse-power being secured from the Canadian Niagara Power Co. will be installed.

The first instalment of power received from the Canadian Niagara Co. has now been added to by a second 12,500 h.p., which was taken over within recent weeks. For the new double line out of Toronto the plans and specifications have been completed and the right of way is being acquired. The new right of way, it is stated, will include sufficient room for the construction of a radial railway between Toronto and Dundas when in the future it is decided to go ahead with it.

Will Link Up Plants

The attention being given the Niagara district does not leave other districts neglected, the Commission undertaking at once the building of two connecting lines in the Owen Sound-Collingwood district to pool the power resources of the four development plants now operated by the Commission there—the Big Chute, Eugenia Falls, Swift Rapids and Wasdell Falls plants.

The Commission is building thirty-five miles of transmission line from Collingwood to tap the Eugenia Falls line to Owen Sound, thus linking up the Falls development with the Big Chute. A six-mile line from Wasdell Falls meeting the Orillia line from the Big Chute completes the circuit. Eugenia Falls has a power surplus of 4,000 h.p., while Wasdell Falls has 1,000 h.p. more than is being used in that district. This surplus gives the Commission almost immediately the added supply needed to serve the municipalities hitherto depending upon the Big Chute, or a total supply from all four developments of 15,000 h.p. The Commission estimates that with the increased development possible at the Big Chute and the developments yet to be made on the Saugeen and Severn Rivers there is an ultimate development in the district of 25,000 h.p. When this is all in use at some future date the northern municipalities can be linked up with the Niagara system by a six-mile line at Forest.

The tremendous increase in consumption is heavy, due to the demand from all over the system. New municipalities are being added, and those already in are increasing consumption steadily. A part of the increase is due to the manufacture of munitions.

EVOLUTION OF HYDRO-ELECTRIC UNITS.

IN a paper entitled "Ten Years of Evolution of Hydro-Electric Units," read before the Western Society of Engineers, Messrs. G. B. Gillicott and W. B. Jackson state that it is now possible to build water-wheel units for high heads at 8 per cent. greater efficiency and as much as 50 per cent. greater speed than was possible ten years ago. Instead of a fixed speed for a certain horse-power output, at a given head, it now appears practicable by improved design to construct units for any speed within the limits of the former fixed speed and approximately 50 per cent. thereof without sacrificing either efficiency or output.

The increase in capacity of low-head wheels primarily has been made possible by the perfecting of the step bearing to a point which permits the carrying of the great weight of the single runner and revolving field of the generator, and, therefore, of the construction of deffective vertical water-wheel generator units. Difficulties encountered in manufacture have been overcome and it is now practicable to cast runners in sections, assemble into a complete runner, and obtain the efficiency of the tested model. This method of construction has proved so satisfactory that one manufacturer has made a proposal to furnish a single-runner unit of 50,000 horse-power capacity.

COMPUTING VALUES OF TUNGSTEN LAMPS.

IT is well-known that a change in the voltage applied to the terminals of an incandescent lamp changes the candle-power, current and, in consequence, the wattage (watts=volts × amperes), and the watts per candle. If these changes are followed from point to point, relations among the variables may be found and plotted as characteristic curves. The equations of these characteristic curves for tungsten lamps have been found by the Bureau of Standards of the United States Department of Commerce, and a special application of these equations has been made in a device which gives a solution of problems involving voltage, candle-power, and watts per candle.

In this device the volt scale is movable, and, by setting it to the other scales at a point corresponding to the observed watts per candle, values of per cent. candlepower and of actual watts per candle may be read directly from the proper scales, or the converse problems may be solved. Use of this device results in a decided saving of time when compared with other methods of characteristic evaluation. In connection with the device are given tables of values used in its construction and practical examples illustrating scale settings.

CARE OF BRUSHES FOR COMMUTATORS AND SLIP RINGS

SUPERFICIALLY, the care of brushes is simple enough, says C. H. Smith in the Electric Journal, but, in fact, quite the contrary is true. Properly selected and applied brushes may fail on account of neglect, while improperly selected and applied brushes may render acceptable service if given intelligent care. Proper care of the brushes and brush rigging is a fundamental of good commutation, and of prolonged life for both commutator and brushes. Operators of electrical apparatus are directly responsible for the majority of their commutating troubles, although the manufacturer is frequently held to account. There are, on the other hand, a few (a very few) who give such superior attention to their brushes that inherent brush and machine evils are rarely permitted to assert themselves. The following practices will more than justify the effort:—

1—Keep the brushes clean. Both direct and alternating-current brushes get dirty—become coated with carbon and copper dust, which packs between the brush and holder and jams or "freezes" the brush in the holder. This frequently results in broken brushes, a gouged commutator, or both, concluding with a "flat spot," and necessitating the grinding or turning of the commutator. The commutator is blamed; the brush did the damage; negligence was the cause.

2—Have the spring pressure uniform. Otherwise, the brushes will commutate unequal currents; overload some and underload others; overwork some shunts and underwork others; cause an excessive flow of current between the overloaded brush and holder, and brush and spring; burn the sides and tops of the brushes and destroy the pressure springs. This unbalanced effect of brush work is sometimes known as "selective commutation"—not so descriptive a term perhaps as "unbalanced commutation," "unequal commutation," or possibly some other, which might have been selected. However, after the meaning of a term is understood, it matters very little what the spelling is.

3—Fit the brushes to the commutator properly, disregarding looks, and there is nothing "easy" about "grinding in" or "sandpapering" brushes. This apparently simple performance requires patience, care and judgment. Too much haphazard indifference is exercised in the seemingly simple act of making the brush face conform to the commutator surface. Examine indiscriminately the faces of the brushes on a few machines. The chances are that the brushes on nine out of ten of them will show imperfect brush contact surfaces; two or more contact faces may be clearly discernible on a single brush; one or more corners may be ground away; the heels or toes or both may be "nosed" off; or perhaps, worse still, the faces may show comparatively large areas of inactive surfaces. When "grinding in" brushes keep the sandpaper against the commutator. Do not allow it to "belly," "bow" or "buckle," unless convinced that cornerless, heelless, toeless, ball and cylinder faced brushes are the proper things. Knowledge of what is being done, and why, is necessary for most men if their interested efforts are to be expected. The average man if told why will learn how, but only a few learn both why and how for themselves.

Grinding-in Brusher

When a new set of brushes is installed it is frequently possible to purchase in the local market sandpaper or garnet paper, or their equivalents (these papers are made in rolls of 25 to 50 yards, or more), in any lengths required to go around a commutator. It should have a lap of several inches, and be so mounted on the commutator as to preclude the lapped end butting against the brushes when the machine is rotated for grinding. With many commutators the friction between the commutator bars and sandpaper (if the paper is taut) will suffice to keep the paper from slipping, especially if when, starting, the paper is given a pull in the direction of rotation by the operator. If the paper persists in slipping, use a little glue to stick the under end of the paper at the lap to the commutator. All traces of the glue must be removed from the bars before putting the machine into service.

A second method is to remove the middle brush on each arm and bind the paper to the commutator by running tape or string entirely around the periphery. If necessary, also bind the paper at the inner and outer ends of the commutator.

After the paper is anchored the commutator may be rotated by hand, or in any convenient way. Great care must be exercised in "grinding in" brushes in this way, as the cutting is very rapid, especially with soft brushes, and much of the life of the brush may be ground away in a very few revolutions. If after the brushes have been surfaced in the above manner, the trailing edge shows a poor seat on account of having had to mount the ridge due to the lap in the paper, a final surfacing should be done with very fine sandpaper by hand. The foregoing method is particularly desirable when a machine has very hard brushes, or a large number of soft brushes. It is a great time-saver after the knack of applying and anchoring the paper is understood. With slip rings, if carbon or graphite brushes are used, the same general scheme is applicable, but if metal graphite brushes are used, emery cloth, or its equivalent, is preferable.

There are those who advocate and those who practise pulling the grinding paper in the direction of rotation in order to more accurately surface the brush. This seems logical enough on first thought, but inasmuch as the commutator is not in motion when the brushes are surfaced in this manner there is no assurance that the brush will bear the same relation to its holder (and therefore to the commutator) when the commutator is rotating and, consequently, no assurance that the contact will remain fixed. This perhaps explains why brushes frequently show perfect contact when idle, but poor contact when in service. Generally speaking, this method of fitting the brushes, therefore, is not necessarily more dependable than other methods, though in proven instances it is to be commended.

4—It is important that the brush-holders, whether for direct or alternating-current use, be neither too close to nor too far from the commutator or slip rings. A suitable distance is from three-sixteenths to one-quarter of an inch.

5—If the brushes are copper-coated, the coating should not be allowed to come in contact with the commutator or slip rings. This means that as the brushes wear the copper coating should be scraped back and not allowed to extend below the brush-holder box. With proper shunts there should be no need for copper coating from an electrical standpoint, although for mechanical reasons it may be desirable as a protection for soft or structurally weak brushes.

6—If the toe of the brush is very sharp, it is good practice to "nose off" the knife edge. This reduces breakage and militates against gouging into the commutator.

Care of Commutators and Slip Rings

The care of commutators and slip rings is so closely related to the care of brushes that a few pertinent requirements may be regarded as applicable.

1—Keep the commutators and rings clean. When in service use a dry canvas or some related cloth having a hard texture. When soft, "nappy" materials are used the "nap" is caught by the slots or rough spots and pulled under the brushes, where it lodges and helps to collect and hold dirt and carbon. When shutting a machine down it is good practice in most cases to clean the commutator with a little gasoline on a hard surfaced material. This not only removes any grease or oil from the commutator, but also frequently improves the brush condition by removing from their faces the residue of greases or oils collected by them.

2—If the mica is flush, see that it is kept flush. If holes appear in the mica, clean them thoroughly and fill them with a dependable filler. Dental cement is perhaps as desirable for this purpose as anything to be had at the present time. These holes are generally traceable to the too free use of lubricating oils, many of which attack the shellac in the mica and rob the mica of its binder. This trouble in its incipiency is of very slow growth, but later increases rapidly, due to the increasing amount of carbon, copper, and other dust which collects in the holes and enlarges the burning area subject to the short-circuits which take place between the bars.

3—If the mica is undercut or recessed, keep the slots clean. For this purpose the use of fibre, bone, horn or hardwood is more desirable than metal, for the reason that metal is likely to cut the mica and deepen the slots. The advantage of deep slots are all disadvantages. Both practically and theoretically, mica need be but a hair's breadth below the surface to accomplish the end desired. The shallower the slot, the better. Depth encourages the collection of carbon, copper, dirt, etc., and is responsible for the bridging of the slots, which necessitates the beveling of the commutator bars.

4—Keep the edges of the commutator bars beveled or chamfered. When slots are deep (as most slots unfortunately and unnecessarily are), the commutator bars pull, or drag over, especially on the lagging edges of the bars. Unless the edges are beveled this pulled-over edge will, in time, close or bridge the slots and cause "flash-overs"; also melted-out connections between the necks of the commutators and windings, and even burned-out armature windings. These things not only may happen, but have happened.

5—Keep the necks of the commutator clean. Dirt between the necks is not only bad for the commutator, but affects adversely the ventilation and, therefore, the temperature of the machine.

6—If the machine "flashes over," shut it down and remove all blisters or burned spots; otherwise the brushes will be unnecessarily worn away, and the commutation will be imperfect.

7—In the matter of slip rings, keep them clean, including studs, spider (or bushing), leads to armature windings, brackets or supports for brushholder yokes, and all insulation between the several parts.

HOT BEARING EXPERIENCE.

THE test of years in practice has proved that the oil ring method of lubricating bearings is entirely satisfactory, says E. C. Parham in the General Electric Review. Although it is seemingly obvious that the following precautions should be taken, past experience has shown that it is necessary to call attention to the facts that (1) there must be oil in the oil-well, (2) the oil rings must be installed, and (3) the oil rings must turn.

Complaint was made that the lining in one bearing of a motor armature had melted twice, notwithstanding the fact that the oil had been renewed just as often as had that of the other bearing which had given no trouble. The motor, being started and stopped by means of an automatic panel and being almost inaccessible, was not given daily attention. It would operate for about five days and then the bearing heating would produce a binding effect which would cause the motor circuit-breaker to open. The opening of the breaker was all that prevented the babbitt metal from running out and letting the armature down onto the pole pieces. An inspector, who was sent to locate the trouble, noticed that the floor was much more oily under the trouble-giving end of the motor than at the other end. This suggested that the oil flooding could not have been due altogether to careless oiling, for then the flooding at both ends would have been about the same. Inspection of the oil-well showed that there was but little oil in it although the other bearing was nearly normal: both bearings had recently been washed out and refilled. On refilling the oil well and carefully wiping the outside of the box, a crack was discovered through which the oil slowly oozed out. This was stopped by drilling, tapping and plugging a hole in the affected area.

Power Equipment at the National Steel Car Co. Plant

Staff Article

The power requirements of large producing plants are frequently as diversified as they are onerous. Steam, air, water and electricity are equally essential to continuous and economical output from these works. Utilization of local electric supply simplified initial installation work and allowed full attention to the continued maintenance of plant efficiency.

ON the tenth day of September, nineteen hundred and twelve, several carloads of construction material arrived on a stretch of land on the eastern outskirts of the city of Hamilton, in the Province of Ontario, Canada. Such an occurrence has taken place on many occasions throughout the country and to the casual observer at that time, the incident was probably neither more nor less interesting than hundreds of other similar incidents. If the observer could have foreseen the extensive plant which was to arise on the surrounding land, and realized that within 4½ months the shipment of finished railroad cars would be an accomplished fact, he would have been constrained to pay more than passing attention to the seemingly ordinary event of a few freight cars arriving on a piece of vacant ground.

The land referred to is situated at the eastern end of Burlington bay, on the southern foreshore of that inlet and less than 30 minutes ride on the city cars from the Canadian Pacific or Grand Trunk Railway depots. It has an area of almost 58 acres, being 800 ft. wide and 3,150 ft. long. It is quite level naturally and being of rectangular shape is admirably adapted for the specific purpose of the plant erected on it.

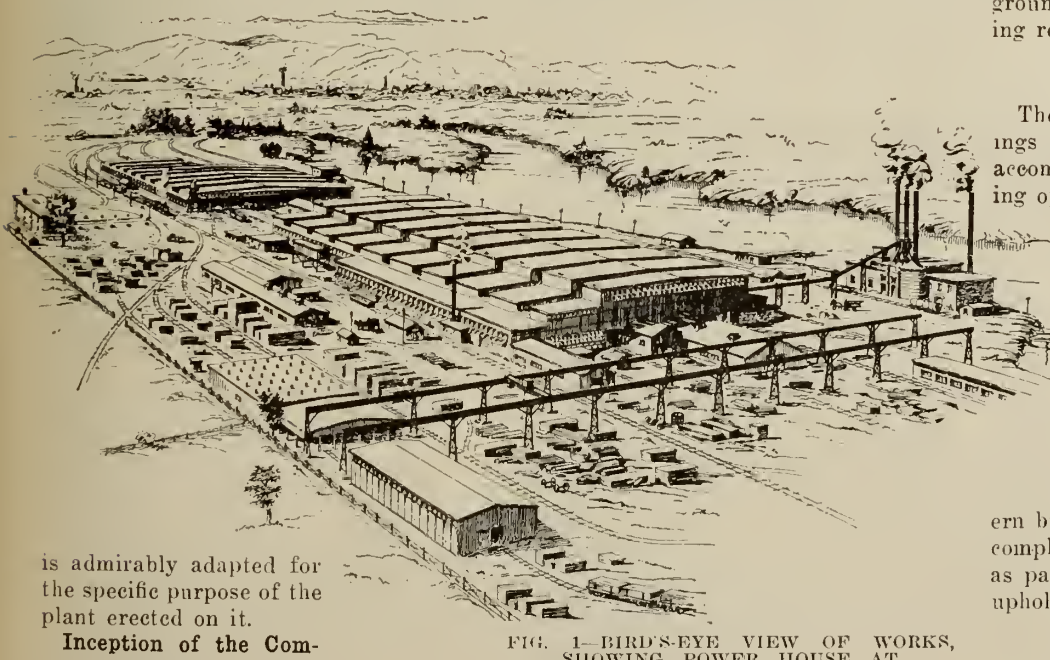


FIG. 1—BIRD'S-EYE VIEW OF WORKS, SHOWING POWER HOUSE AT EXTREME RIGHT.

Inception of the Company

Incorporated on July 11, 1912, the National Steel Car Co. was organized by a group of prominent Canadian capitatlists to undertake the manufacture of all types of steam, electric and street railway passenger and freight car equipment. Taking place as it did when car works were being rushed for deliveries, the inception of the business was attended by some delay in obtaining the desired amount of trained help. Fully 90 per cent. of the workmen were recruited from the ranks of the local inhabitants and as it was necessary to train them in the art of car building, the desired state of efficiency was not obtained so quickly as it otherwise might have been..

Under these circumstances, therefore, the feat of erecting and equipping shops, organizing a force and making shipment of completed cars on Jan. 31, 1913, less than five months from the breaking of ground is deserving of more than passing remark.

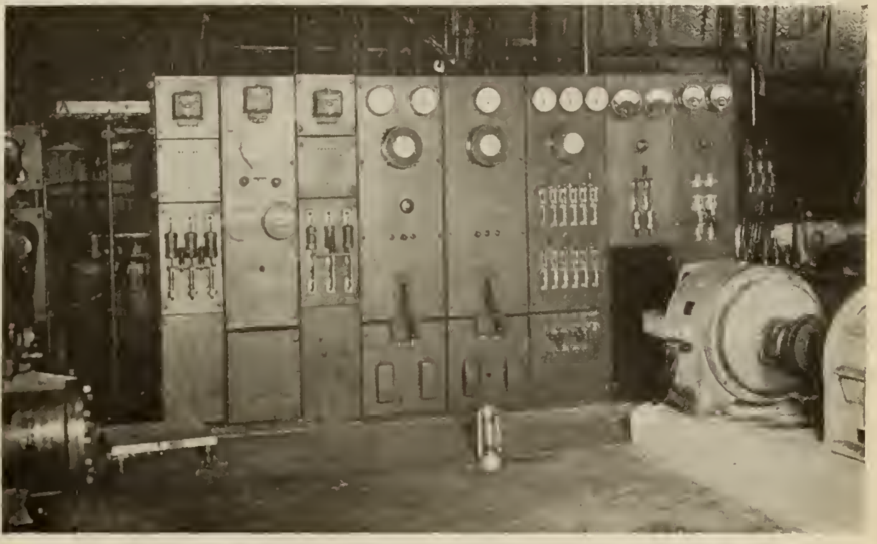


FIG. 2—MAIN SWITCHBOARD IN POWER HOUSE.

General Features of Plant

The plant consists of two large buildings which contain the equipment for accomplishing the principal manufacturing operations, while several buildings are provided for various purposes, such as office buildings, storage, hospital and works offices. The two main buildings referred to are situated north and south of each other, the northern one being known as the main shop in which are located the steel and woodworking plants. The southern building is devoted to passenger car completion, including such departments as painting, decorating, cabinet making, upholstering, etc.

Power Requirements

Most of the equipment in the main shop consists of powerful machine tools, more or less separated from each other and of medium power requirements so that individual motor drive is practically universal throughout the plant. With the exception of the machine shop, very little group driving has been accomplished.

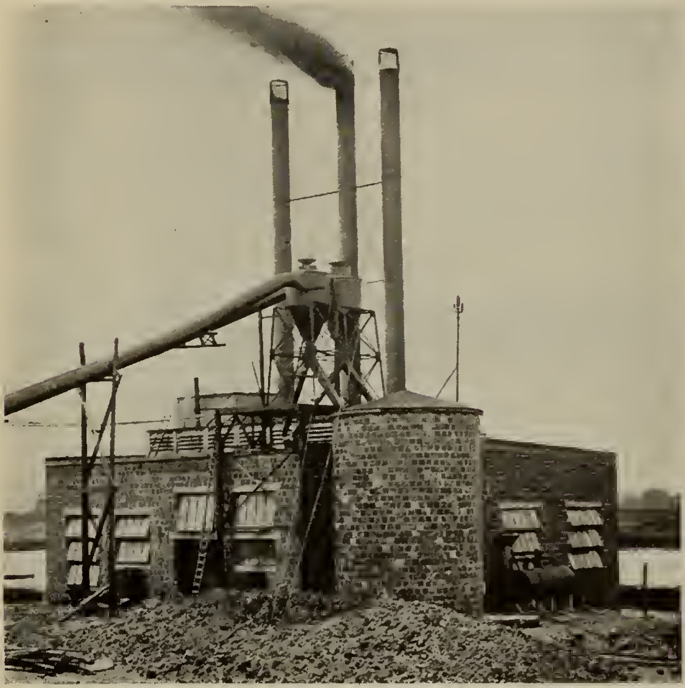


FIG. 3—POWER HOUSE WITH SILO FOR WOOD WASTE.

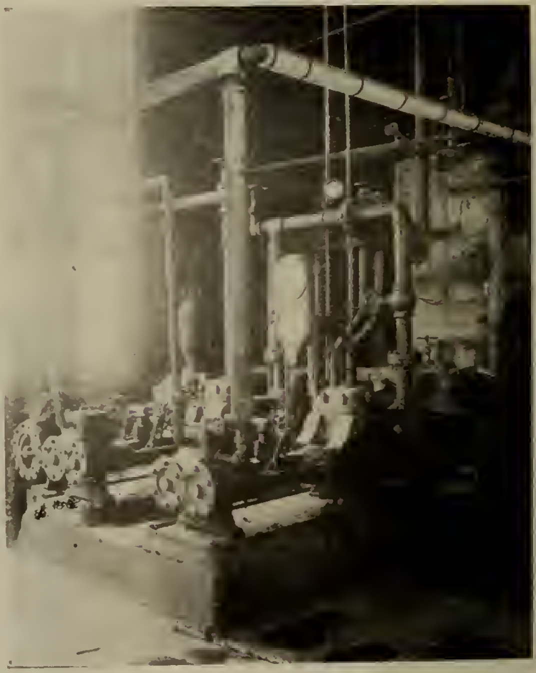


FIG. 6—BURNHAM BOILER FEED PUMPS WITH COCHRANE FEED WATER HEATER BEHIND.

Hydraulic power is necessary to operate a number of forging presses, and a liberal equipment of pneumatic appliances such as riveters, drills, etc., involves a supply of compressed air. Steam is required for such purposes as dry kiln heating, steam chests for veneer presses, and steam drop hammers in the forging department.

Distribution Systems

The wires and pipes distributing these four forms of energy are carried throughout the plant in concrete trenches about 3 ft. wide by 3 ft. deep, the power house from which they start being shown to the right of the bird's-eye view, Fig. 1, of the plant, which also shows the main shop in the centre and the finishing departments in the distance.

Owing to the fact that electric power was conveniently obtainable from the local supply company, no generating plant was installed, the electric equipment being confined to a transformer installation with suitable distributing equipment.

Boiler Installation.

The original power plant building as shown in Fig. 3, is 65 ft. wide by 90 ft. deep and is divided into two portions by a brick wall running across the building which is of steel frame construction with hollow fire proof tiling walls. The front portion is the boiler house contains three 250 horse-power boilers with the necessary feed pump installation.

Hand Fired Dutch Oven Furnaces

As will be observed from the illustration of the firing floor, Fig. 4, the furnaces are hand fired. Two of the boilers are built as a pair, the third one having an independent setting. They are of the Erie City water-tube type and have the furnaces specially arranged for burning the wood shavings and waste from the planing mill department. All of the woodworking machines are piped to a large Sheldons steel plate exhaust fan of ample capacity which after drawing off the shavings, forces them through a discharge pipe for a distance of 200 ft., the latter portion of the pipe having an upward slope of about 20 degrees till it reaches a point about 60 ft. above ground where it discharges into a separating chamber, supported by a light steel frame work on the roof of the boiler room. The lighter dust is here allowed to escape to atmosphere while the heavier pieces drop down through suitable pipes, one set leading to the furnace and the other set to the silo or circular storage chamber which is used to receive waste when not required for the furnaces. An additional

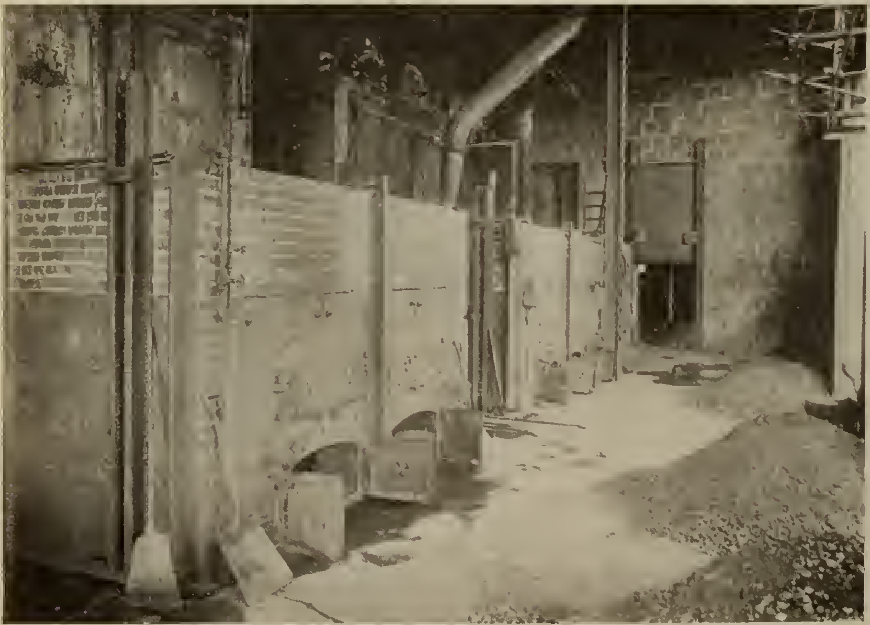


FIG. 4—FIRING FLOOR IN BOILER HOUSE, SHOWING THREE 250 HORSE-POWER WATER-TUBE BOILERS WITH DUTCH OVEN FURNACES FOR BURNING WOOD WASTE.

boiler house has since been erected in which three Goldie and McCulloch water-tube boilers are installed, one pair and one individual, all being of 300 horse-power each.

Feed Pump.

The boiler feed equipment , see Fig. 6, consists of one Burnham simplex, and two Buffalo duplex outside center packed plunger pumps which receive water from a Cochrane feed water heater and purifier. The considerable boiler capacity mentioned is largely required for the steam driven plant in the engine room. Recent extensions to the hydraulic forging plant have increased the pumping capacity until four Burnham compound steam pumps are kept in constant service. These pumps shown in Fig. 7 supply water at a pressure of 1,500 lbs. per sq. in. to the main pipe line which is also coupled up to a 90 ton accumulator for maintaining a steady pressure. As shown in the illustration the four compound steam pumps exhaust into a jet condenser served by a Burnham simplex air pump shown at the right of hydraulic pumps.

Compressed Air

Entering the main exhaust pipe just before it reaches the condenser is an overhead exhaust pipe which comes from the air compressor on the opposite side of the room see Fig. 8. This machine is of Canadian Rand make and is a cross compound corliss engine two stage compressor. The steam cylinders are 18 in. and 34 in. dia., the air cylinders being 20 in. and 32 in. dia., with common stroke of 36 in., delivering air at 90 lbs. per sq. in.

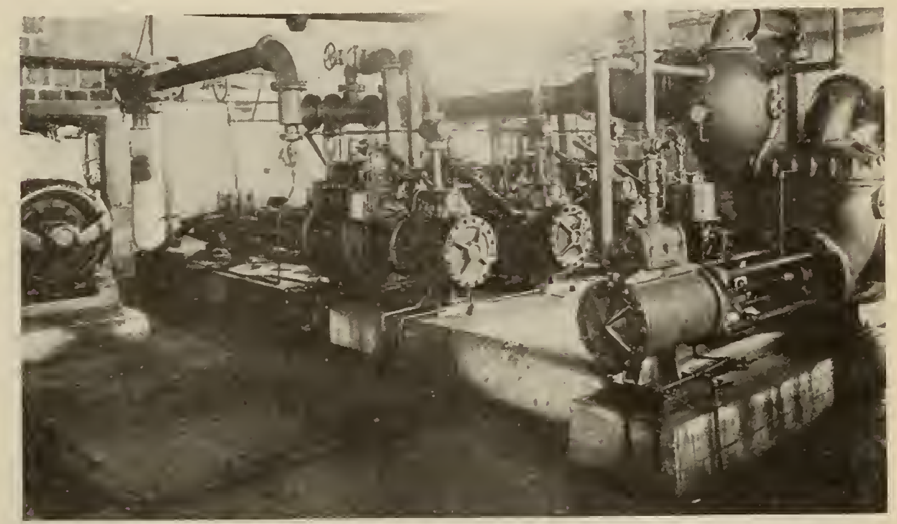


FIG. 7—COMPOUND CONDENSING HIGH PRESSURE BURNHAM PUMPS WITH JET CONDENSER.

Fire Service.

Fire service is provided by both steam and electric driven pumps shown in Fig. 9. The large duplex steam pump in the center is a Buffalo underwriters' fire pump 18 in. x 10 in. x 12 in. with a capacity of 1000 gals. per min. which is sufficient to maintain good streams from four 1½ in. smooth bore nozzles.

LIQUID FUEL ENGINE EXHAUST

A PAPER was recently read before the Institution of Mechanical Engineers, in the course of which Lieut. R. W. Fenning described experiments conducted with a view to determine the composition of the exhaust from liquid fuel engines. From these experiments he arrived at the following conclusions:

(1)—With volatile fuels there is but little difference in the composition of the products of combustion resulting

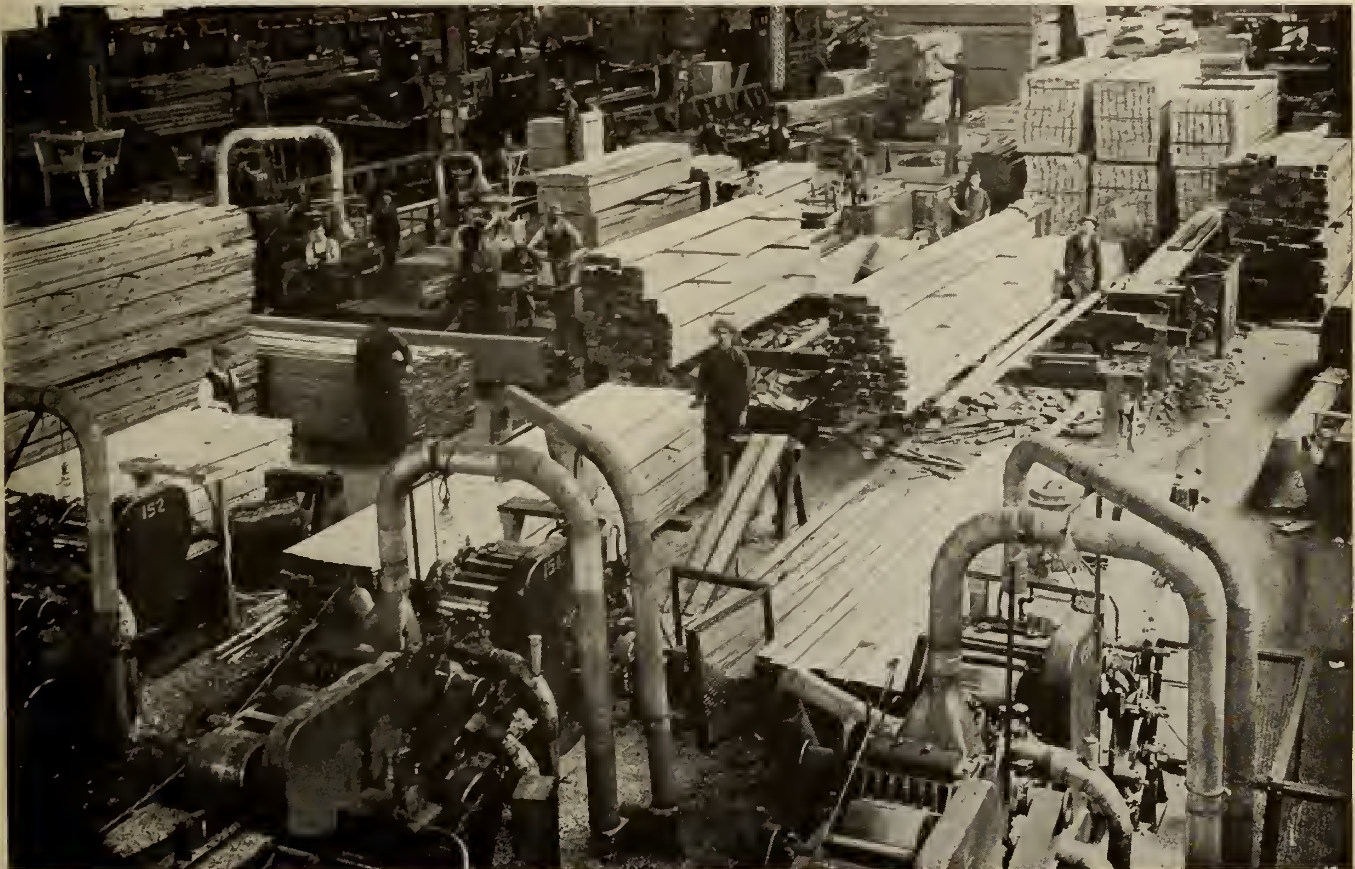


FIG. 5—VIEW IN PLANING MILL SHOWING MACHINES FITTED WITH EXHAUST PIPES FOR CONVEYING SHAVINGS AND WASTE TO POWER HOUSE.

from air-fuel mixtures in a small explosion vessel or in an engine cylinder, in spite of the conditions being so dissimilar. In fact, the agreement between the CO_2, O_2, and CO values in engine and explosion-vessel tests is so close that an exhaust gas chart prepared from explosion-vessel tests can be used to estimate the strength of mixture supplied to an engine.

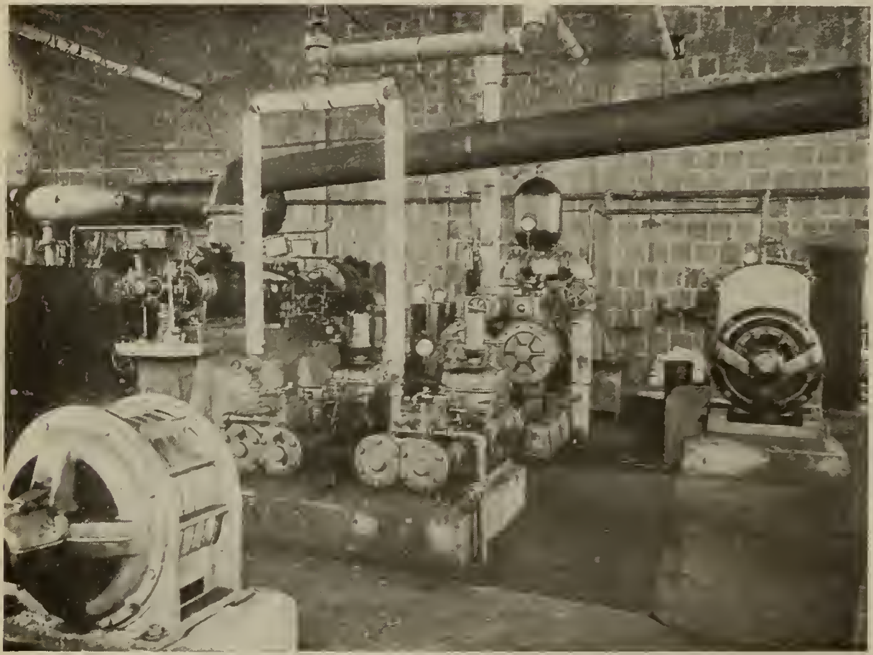


FIG. 9—SHOWING 1,000 GALS. PER MIN. UNDERWRITER FIRE PUMP.

(2)—A very small quantity, if any, of unsaturated or saturated hydrocarbons is present in engine-exhaust gases. Taking a particular instance, methane is almost entirely absent.

(3)—The hydrogen constituent in exhausts from strong mixtures is an important item, and increases in value rapidly with increase in mixture strength.

(4)—The ratio of air to fuel in the orginal mixture can be calculated with a considerable degree of accuracy from the composition of the exhaust gases.

The reliability of Dr. Watson's method and apparatus for measuring the air and fuel supplied to an engine is once more demonstrated. It has been shown by Dr. Watson and others that mixture strength has a considerable influence on the thermal efficiency of an explosion engine. Given an exhaust gas chart for the fuel, the strength of mixture can readily be found from an analysis of the exhaust gases. Why not, the author said, adopt this method when setting carburetors and thus promote fuel economy, lessen carbonization, and minimize the pollution of the atmosphere by such poisonous gases as carbon monoxide?

* * *

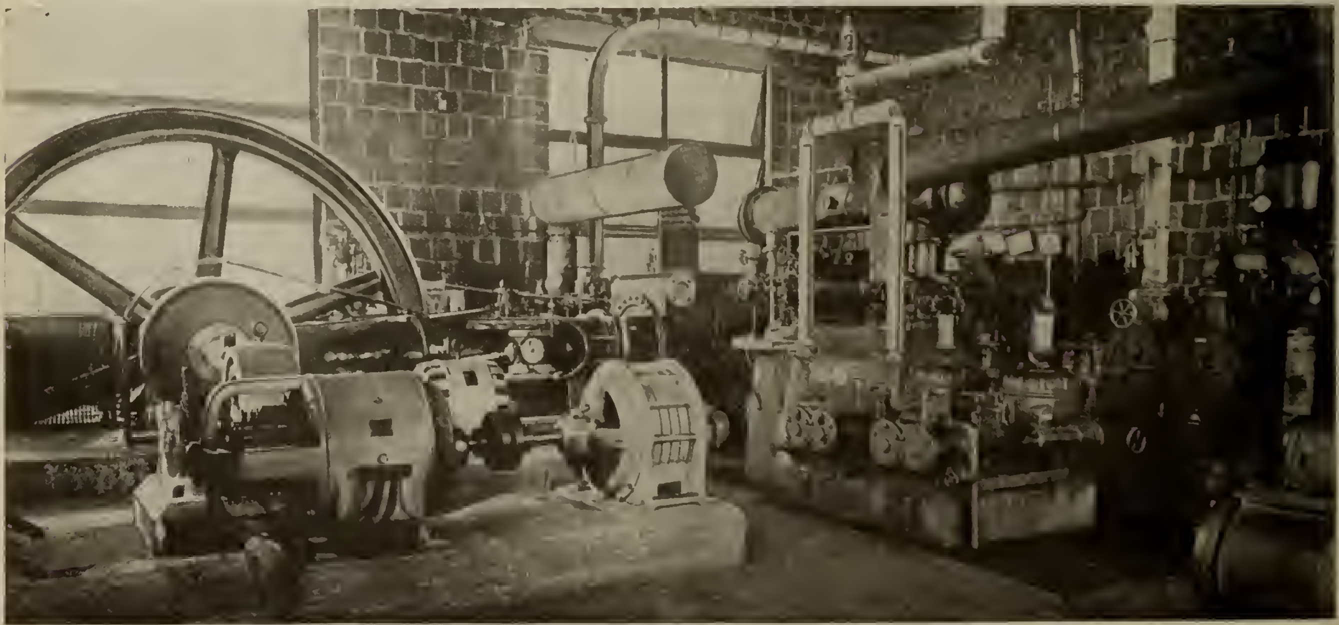
SOME LANGUAGE

IN Dallas, Tex., a railroad manager received the following letter: "Gentlemen, —Is it absolutely necessary in the discharge of his duty, day and night, that the engineer of your yard engine should make it ding and dong and fizz and spit and clang and bang and buzz and hiss and bellow and wail and whistle and wheeze and squak and blow and jar and puff and bump and click and clang and chug and moan and moot and toot and crash and grunt and gasp and groan and jerk and rasp and jingle and twang and clack and rumble and jangle and ring and clatter and yelp and croak and howl and hum and boom and clash and jolt and jostle and slam and scrape and throb and crink and jangle and quiver and rumble and roar and smell and shriek like —"—Chicago Tribune.

* * *

COMPUTING BELT WIDTH

IN making computations for belt width this is how one manufacturer does it: Where the belt is to be single thickness, he multiplies the horse power to be transmitted by 660, and divides by the peripheral speed of the belt in feet per minute. The result is the width of the belt in inches. For a double-ply belt, he multiplies the horse power to be transmitted by 415, and divides by the peripheral speed of the belt in feet per minute. The result is in inches of width. If the belt is to be three-ply, he multiplies the horse power to be transmitted by 330, and divides by the peripheral speed of the belt in feet per minute. The result, again, is in inches.



CROSS COMPOUND CORLISS STEAM-DRIVEN AIR COMPRESSOR 18 X 34 AND 20 X 32 X 36 IN. STROKE.

Power Transmission Section

TRANSMISSION SAFETY—IV.

In some plants arrangement is made whereby the man who oils the shafting comes early in the morning and does his work before the engine is started up. In some respects this is an excellent idea, but like every other method of doing work it has to be carried out in accordance with a definite and intelligent plan if accidents are to be avoided. The oiler should first report to the engineer that he is about to oil the shafting, and he should again report to him when he has completed his task; and the engineer should be instructed not to start the engine until he has received definite word from the oiler in person, to the effect that the oiling is completed.

The way in which accidents are likely to happen in connection with this program is fairly evident. The oiler, when he has finished his task, sometimes omits to inform the engineer that he is through and the engineer, having received no word when it comes to start the engine, does not know what to do. If he does start the engine he may kill the oiler, while if he does not do so he may be delaying the day's work quite unnecessarily. In one case that we have in mind the engineer made a practice of looking over the plant under these circumstances, to see where the oiler was; and he invariably found that he had gone away and forgotten to leave word. The engineer then returned to the engine room and started the machinery.

After having done this a number of times he began to take it for granted that the oiler had merely forgotten to bring him the message, and thereafter he started up at the regular time without taking the trouble to look through the shop. It is evident that when the thing is managed in this way there is a strong probability that sooner or later the machinery will be set in motion while the oiler is in a dangerous position, and he will be likely to be killed or badly injured in consequence. Hence it is of paramount importance when this plan is adopted, to see that the oiler invariably passes the word to the engineer as soon as he is through with his work.

Protruding Dead Ends of Shafting

All protruding dead ends of shafting should be boxed in or guarded with wire mesh, unless they are more than 7 feet above the floor. All horizontal shafting and all pulleys that are not more than 7 feet above the floor should also be inclosed, or be guarded by standard railings at least 42 inches high, placed not less than 15 inches from the point to be guarded. Safety couplings, collars and set-screws should be used in all cases. Take suitable precautions to prevent pulleys from working off at the ends of their shafts, and provide a clearance of at least 36 inches between every pulley and the nearest shaft bearing. If this is not feasible a screen guard should be located between the pulley and the shaft bearing.

Projecting Keys

Another source of danger to workmen who are oiling or repairing shafting or pulleys is the projecting key, which causes more trouble than many of the larger parts, though it often escapes notice on account of its small size. The danger is, that the key will catch a workman's clothing, cause the cloth to wind up around the shaft, and whirl the man around and seriously injure him. All projecting keys should therefore be effectively guarded. These precautions should be taken not only in the places where the men are most frequently required to work, but also throughout the entire plant; because the men, when called upon to do repair work in out-of-the-way or cramped quarters, are likely to forget that the dangers are not guarded there as well as in other places. It is hardly more dangerous to leave them all unprotected, than it is to give a false sense of security by attending to only a part of them.

A competent mechanic should be assigned to the work of inspecting the power-transmission equipment, and he should examine all parts of it carefully and at regular intervals. Such inspections often disclose dangerous conditions.

◆

STRENGTH OF GEAR TEETH

WHILE the exact load that should be transmitted by a pair of gears is a matter that requires considerable judgment owing to the many variable conditions involved, the experience of engineers and manufacturers have demonstrated that reliance can be place upon Lewis' formula for the strength of gear teeth. This formula takes into account the shape of the teeth for different numbers of same and the effect of velocity upon shock and wear, as well as the face and pitch of the teeth. The Lewis' formula referred to is $W = s\,p\,f\,y$, from which

$$\text{Horsepower} = \frac{s\,p\,f\,y\,V,}{33000}$$

where W=total pressure in pounds along the pitch line.
s=working fibre stress (in lbs. per sq. in.) of material used in gears, corrected for velocity effect.
p=circular pitch, inches.
f=face width, inches.
y=tooth strength factor, from curve.
v=velocity at pitch line in feet

$$\text{Per minute} = \frac{P\,N\,R}{12}$$

where N=number of teeth.
R=revolutions per minute.

◆

BEARING METALS—BABBITT

THE best combination for bearings is to make the wearing parts of one of a material softer than the other. No doubt the good effects resulting are due to the fact that the softer material yields somewhat to the inequalities of the harder metal, and this giving way of one of the metals permits of easy running. Conversely, the hard, unyielding surfaces of steel on steel have exactly the opposite effect, as neither will give in to the other, and friction naturally follows, causing heating, which again increases the friction until failure occurs.

Within certain limits the more accommodating the soft bearing the better the result obtained, the material generally employed being what is known as "white metal," or "Babbitt," from the name of its originator. This white metal is an alloy of several metals, the proportions varying according to the results desired. Nearly every shop has its own formula for the mixture, but a typical one may be taken as 73 parts of tin, 10 parts of antimony, and 4½ parts of copper. These are melted together in the foundry and supplied in blocks to consumers who heat it to a molten state for use, adding thereafter some 12½ parts of zinc to it. The parts mentioned are by weight.

It is very important that the white metal should be well supported by another metal possessing more strength, as, unless reinforced in some way, it would be crushed and deformed. For instance, in journal boxes it will usually be found good practice to cast the bearing area with recesses in the face, into which the white metal is run, the whole being then turned up with the axle, so that the actual bearing face is partly bronze or cast iron, but more largely white metal. In some cases it is possible to make one of the wearing faces entirely of white metal, in which a very thin layer is attached to the harder metal. Even in such instances, however, it will be found best to provide for the harder metal to project all round the Babbitt, to prevent the edges breaking off. At least some form of "key" will be necessary, such as serrations in the hard metal holes in which the white metal can penetrate and get a grip.

The Tinning Feature

The problem of attaching the two metals together is one that the operator must effectually solve, as on the success of his workmanship rests the whole responsibility for good results to be obtained in the after-work of the engine or machine when running. The article to be Babbitted must first be thoroughly cleaned from scale or rust at those parts which are required to be lined up. This cleaning is done either by mechanical means such as turning, filing, or chipping, or by chemical means of immersion in an acid bath. The latter method is preferable, but not always possible, so the former is often met with in service. It depends also upon the metal of the part to be lined up, as if this is cast iron it is more difficult to make the white metal adhere to it than if it is a metal more nearly akin to the white metal, such as bronze.

When the surfaces are thoroughly clean, the article is heated to a temperature sufficient to make tin melt freely, say 450 dgs. F. Then a stick of tin is dipped in sal-ammoniac and rubbed on to the parts to be metalled, a very thin coating being deposited. This operation has to be carried on until the whole surface is covered with a layer of tin, and is necessary in order to ensure that the white metal is in firm metallic contact with the article to which it is required to be attached. If no previous tinning were done, the white metal might stick, or it might not, and failure would be probable in the after-working processes or in service. The babbitt is afterwards poured on to the tinned parts, and guided and pressed into position by means of a hard smooth stick of wood. Whilst in a plastic state the Babbitt is easily controlled, and a layer of almost any thickness can be spread on to the skin of tin, to which it will firmly adhere.

⁂

OIL RING BEARING TROUBLE

THE oil ring in a motor bearing failed to turn because it had been distorted into an elliptical shape by a crowding which it had received when the armature had been reinstalled after having been removed for repair. When an armature shaft is shoved into a bearing, the oil ring should be held up with a screw driver or other article of suitable shape. Assemblers accomplish the same result by turning an end shield upside down, for then the ring drops out of the way. Some operators lift the rings and rest them on the boss alongside the ring slot; this is not to be recommended as a general practice for the rings may be forgotten and remain raised out of the oil. Indeed, this has been found to be the cause of trouble in several instances of bearing heating. In these cases, however, the bearing was so inaccessible that only an experienced hand could locate the ring by feeling for it. Another very similar instance took place when a motor had to be disassembled on account of having been through a flood; in reassembling, the rings were left out entirely.

⁂

RUBBER BELT DRESSING

BEFORE applying dressing to a rubber belt, if you have the right kind to apply to that material of belt, brush the latter off thoroughly with a brush that will find the bottom of the dust, then, with a brush or suitable cloth, apply the dressing to the full width of the belt—not in the centre. Remember that the dressing should not be put on so heavy that it causes the belt to incline to follow the pulley and only releases when forced to by natural causes, and then makes a terrible crackling noise when it does let loose. In seeing a belt follow the pulley and hearing the crackling noise in its tearing loose, one must certainly understand that there is not only an unnecessary strain on the belt, but that it is bound to take considerably more power. I have seen rubber belts that had the outer ply of rubber torn off by this practice. The dressing suitable for a leather belt, is pretty apt to rot a rubber belt.

⁂

Where a leather belt becomes so full of oil that it inclines to slip on the pulleys, it is found to be a good plan to wash the surface with ammonia; it is also good practice to use it in washing the surface of the belt preparatory to applying dressing.

REBABBITTING BEARINGS.

IN pouring a bearing on a horizontal shaft, says a writer in the Dodge Idea, cut out only one of the old bearings at a time, using the old on in order to hold and clamp the mandrel. If it is worn out of true or too thin to hold the mandrel in the right position, put in shims of paper as may be required in order to line it up as wanted, then clamp the mandrel in the position it is desired to assume when finished. This being done, wrap the shaft of the bearing to be poured with oiled paper, and around this wrap a twine string spirally from one end of bearing to the other. This holds the paper snug, and, when the bearing is poured and the string removed, there remains a nice oil channel.

Arrange to pour both the top and bottom of bearing at the same time. This is done by cutting the liners so that they fill out to the shaft nicely, afterwards cutting some notches at intervals for the metal to pass through to fill the bottom. This will leave small strips of metal between the top and bottom, but a thin cold-chisel, driven carefully between the ends of the cap and bottom portions of the bearing, will easily break them apart. Make a funnel of clay or putty around the hole, to hold a surplus of metal, so as to get the benefit of the pressure to insure complete filling of the bearing. The bearing is now ready for the metal.

In heating be sure to not get it too hot. This, in my opinion, is where some of the springing trouble starts. Heat until the metal will just brown a dry pine stick. If both the top and bottom are poured at the same time, there is little, if any, danger of springing the shaft. The metal, of course, falls on the top of shaft, but it immediately starts down the sides, following around the shaft on both sides and passing through the openings in the liners into the bottom. By pouring as fast as it will run, it is only a few seconds until the metal in the bottom has reached the shaft, tending to heat it and offsetting the heat on top. The metal falling down both sides of shaft has tended to spread the heat over a considerable part of its circumference, and the time which has elapsed is so short that there is very little heat absorbed by the shaft, anyway. With the offsetting heat coming from the bottom, it will only be once in many operations, if at all, that trouble will be encountered from this cause. When one bearing has been poured as directed, cut out the next, using the new one by which to clamp and line the shaft, and proceed as above.

EXTERIOR VIEW OF THE MOUNT ROYAL SPINNING MILL, MONTREAL.

Power Generation, Etc., at the Mount Royal Spinning Mill

Staff Article

The Mount Royal Spinning Mill as a manufacturing establishment is one of the most up-to-date of its kind either in Canada or elsewhere. This being so, its departmental feature embracing the power generation and transmission equipment will as might be expected, be found more than ordinarily interesting and instructive by our readers.

AMONG the many industries affected indirectly, by the war has been that of the manufacture of cotton in its various stages. The demand for this product has been enormous, and many plants in all parts of the country have been working to their maximum capacity, in order to meet both domestic and other requirements. Like many other lines of activity however, this industry has greatly suffered through lack of desirable help, and in many instances it has been necessary to overwork the staff.

The plant here described, that of the Mount Royal Spinning Mill, is the property of the Canadian Cottons Ltd., but is at present working under lease to the Dominion Textile Co. This mill covering an area of some 13 acres, was constructed during the years 1907-8, and further additions were made in the year 1909. The main building is 527 feet long and 134 feet wide. It is five storeys high, solid brick construction, with a total floor space of approximately 338,000 sq. feet. The ground floor contains 634 looms—214 Whitin and 420 Keighley. On the first floor there are installed 662 Whitin looms. The second floor constitutes the card room; the third floor, the mule room, and the top floor, the ring frames; each room being equipped with the necessary machinery to prepare the cotton for a total of 1818 looms, of widths varying from 41 to 49½ inches.

In addition to the main building there are two others, each 300 by 78 feet. One of these contains 310 looms and the other 212, of Keigley, and Draper makes. The warehouse is 200 by 80 feet. A modern and fully equipped machine shop, 134 by 49 feet is located on the first floor of the main building.

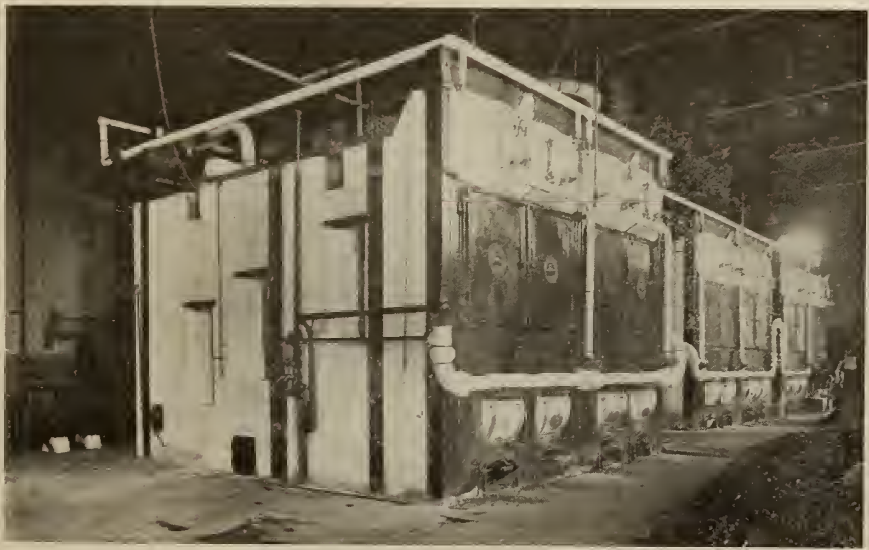


FIG. 1—BOILER ROOM SHOWING THREE BATTERIES OF SIX DOUBLE DRUM TYPE BABCOCK & WILCOX BOILERS.

The boiler room is 123 feet long, 60 feet of the length being 54 feet wide and the remainder having a width of 48 feet. The engine room is 83 ft. by 53 ft.; with a rope race 39 ft. by 21 ft. and of five stories high. Machinery in the main building is driven direct from the main engine, while that in the two smaller buildings is operated by electric motors taking power from the auxiliary units located in the main engine room.

Boiler Room Equipment

The boilers are of Babcock & Wilcox make, arranged in three batteries of two boilers each. They are of the double drum type, rated at 300 h.p., each having 3,140 square feet of heating surface, with a grate surface of 60 square feet; they operate at a working pressure of 175 lbs. per square inch. The boilers are fed by two sets of horizontal "Blake" duplex double acting ram pumps, cylinders being 10 and 6 inches in diameter by 10-inch stroke, each pump being capable of feeding the boilers under full load, allowing one set of pumps being kept in reserve. The pumps

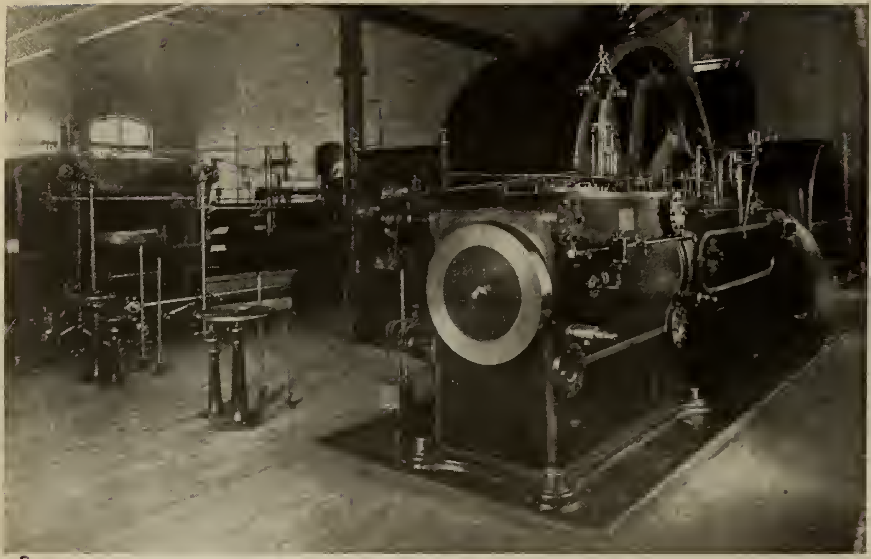


FIG. 2—COOPER 1,800 HORSE-POWER CROSS COMPOUND CORLISS ENGINE.

take water from the hot well, which is heated by the mill returns, pump exhausts, etc. They deliver direct to the boilers through a "Green" economizer. In addition to the feed pumps, each pair of boilers is fitted with an injector, which draws water from the Lachine Canal and feeds direct.

The boilers are coupled together by a complete system of steam piping with a main header for distribution to the engine room; the heating and auxiliary service being on an additional main to supply the washing section. Both mains are equipped with an adequate number of valves, to cut out any unit of the plant. All drains are connected to automatic return traps. The boiler at the far end of the installation is fitted with an "Elliott" stroker.

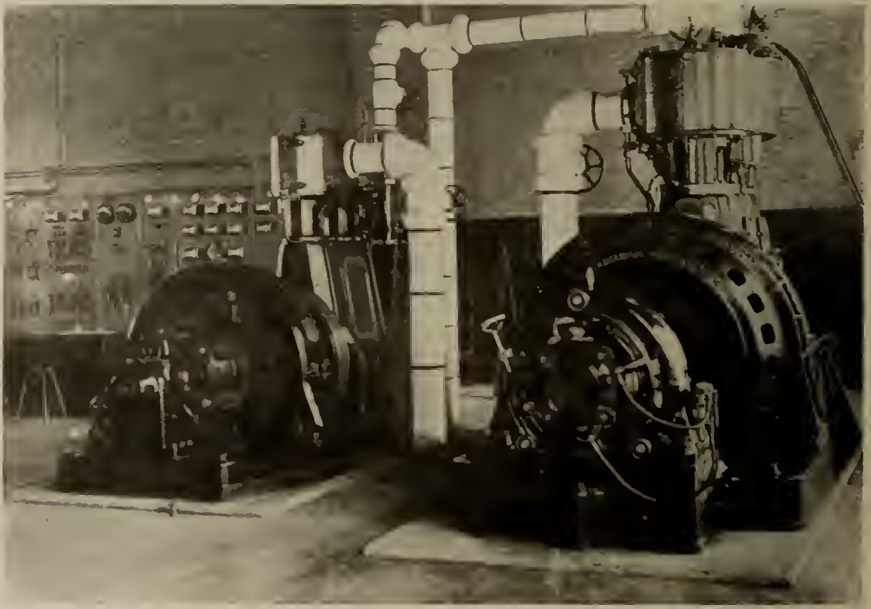


FIG. 3—AT RIGHT, 375 K.W. ALLIS-CHALMERS-BULLOCK ALTERNATOR CONNECTED TO 350 B.H.P. BELLISS & MORCOM CONDENSING ENGINE. AT LEFT, 100 K.W. ALLIS-CHALMERS-BULLOCK ALTERNATOR CONNECTED TO 145 B.H.P. BELLISS & MORCOM CONDENSING ENGINE.

Main Engine Installation.

The main engine, with cylinders 24 in. and 56 in. in diameter by 5 ft. stroke, is of the cross compound Corliss type, built by the C. G. Cooper Co., Mount Vernon, U.S.A., and is rated at 1800 horse power when operating under most economical conditions. It is fitted with Reynold Corliss type cut off valve gears on each cylinder, a simple high speed governor controlling their operation on both cylinders. The engine is designed for an initial steam pressure of 175 lbs. per sq. inch, and to run at a speed of 80 revolutions per minute. A fly-wheel rope drum, 20 feet in diameter in mounted on the crank shaft, between the two cylinders, and drives direct upon the second motion line shafts, for each room or storey of the main mill building, by means of thirty-seven $1\frac{3}{4}$ inches diameter, manilla and cotton ropes subdivided to each floor according to the required power. The engine is fitted with a complete and efficient automatic self-oiling system, having sight feed adjustable drip oilers to every bearing. Provision is made for collecting the used oil and returning same to an overhead oil tank. A heater-receiver is placed underneath the engine room floor in the connecting pipe leading from the high pressure to the low pressure cylinder, the water of condensation arising from same is returned to the boiler by means of an automatic return trap.

The piping and valves on the main unit are so arranged, that the engine can be operated as high pressure condensing, low pressure condensing or non-condensing. The purpose of this is that, in case of accident to either side of the engine involving a lengthy stoppage, the opposite side may be operated independently, at half the rated power. The exhaust from the low pressure cylinder passes into an independent jet condenser equip-

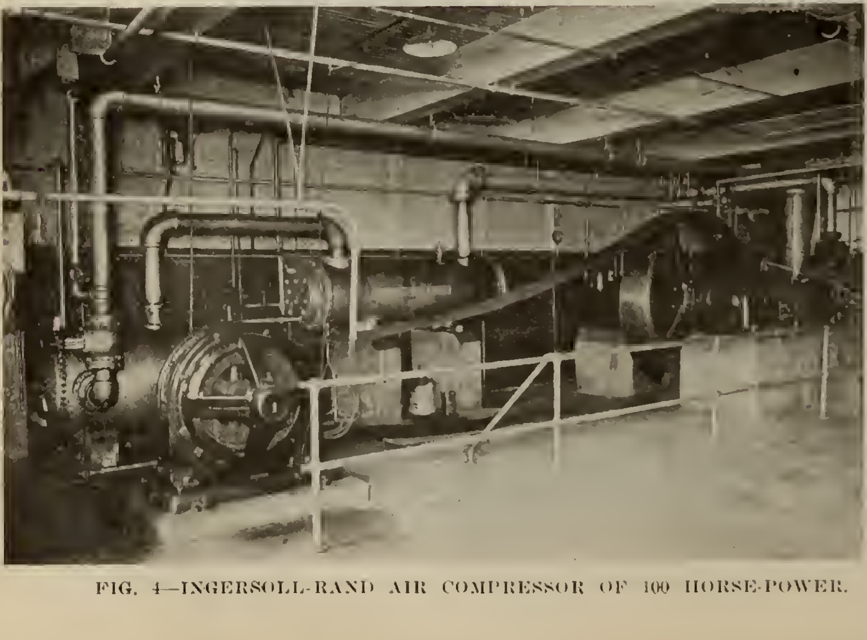


FIG. 4—INGERSOLL-RAND AIR COMPRESSOR OF 100 HORSE-POWER.

ment of the "Dean" type, the water of condensation passing to the hot well supplying the boiler feed pumps. The main engine is fitted with a complete set of pressure and vacuum gauges, etc., these being located on a stand between the two cylinders. All control valves are arranged so as to be within easy reach of the operating engineer.

Auxiliary Equipment

The auxiliary equipment is shown in Fig. 3, and consists of a compound high speed, vertical, condensing engine (on the right), built by Bellis & Morcom, Birmingham, England, and rated at 350 B.h.p. It runs at 360 revolutions per minute and is designed for a boiler pressure of 150 lbs. per square inch. This unit is of the automatic self-oiling enclosed type, and is direct connected to an Allis-Chalmers-Bullock 375 k.w., 600 volt, 360 ampere, 60 cycle, 3 phase alternator, mounted upon a continuation of the engine base plate. To the left of Fig. 3 is shown another compound high speed vertical, condensing engine, built by Bellis & Morcom, rated at 145 B.h.p., operating at 475 revolutions per minute, and designed for a boiler pressure of 140 lbs. per square inch. In other respects, this unit is exactly the same as the larger set described. This engine is direct coupled to an Allis-Chalmers-Bullock d.c. generator, rated at 100 k.w., 125 volts, 800 amperes, the generator being also mounted upon a continuation of the engine base plate.

Main Switchboard

Both engines are arranged to exhaust through the feed water heater, or direct to the atmosphere by means of suitably installed piping, with the required cut out and diverting valves. The main switchboard, shown in the left background of Fig. 3, controls the distribution of the power from the two generating units. This board is equipped with all the necessary instruments and switches, and these, with all other connections, are arranged so as to be easy of access to the engineer in charge. Fig. 4 shows the "Imperial" type, power driven, air compressor, for operating the humidifying system installed throughout the main mill building. This unit is a 100 horse-power Ingersoll-Rand machine, belt driven by a Canadian General Electric motor, which receives its power from the main auxiliary in the engine room.

Fire Protection

The plant is amply protected against fire by a complete and modern sprinkler installation. In addition to a large water tower, there is an 18-10-12 Underwriter fire pump, its capacity being 1,000 gallons per minute, or four 1⅛ inch smooth nozzle fire streams. Water is obtained direct from the Lachine Canal, and when operating under full load, the pump has a speed of 70 revolutions per minute. When operating at full capacity, the mill gives employment to 850 people, two-thirds of whom are women.

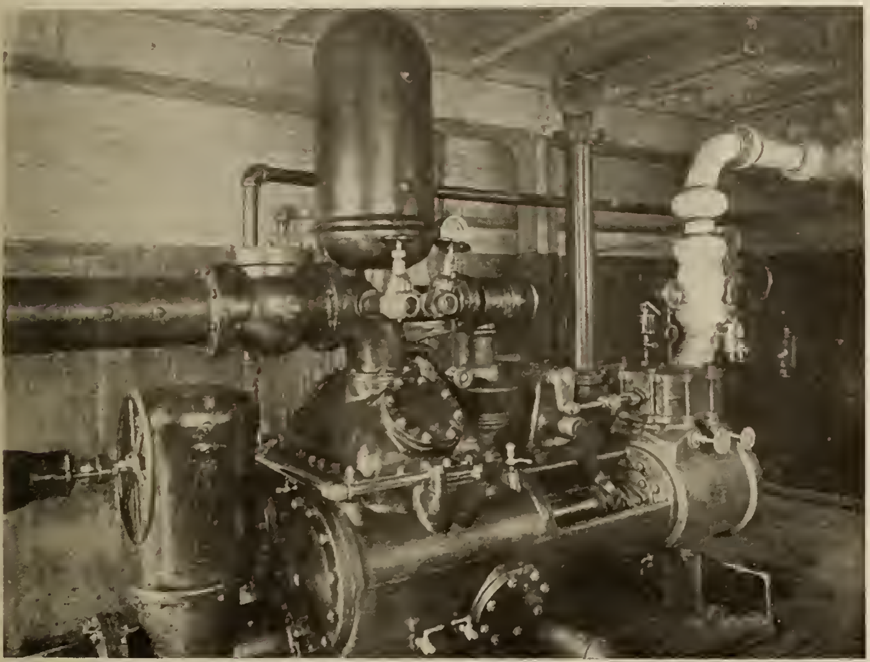


FIG. 5—UNDERWRITER FIRE PUMP OF 1,000 GALLONS PER MINUTE CAPACITY.

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BRITAIN'S MUNITIONS' OUTPUT

IN the course of a long and exhaustive speech in the British House of Commons recently, by the Hon. Mr. Montagu, Imperial Minister of Munitions, much interesting and highly informative data relative to the production of war supplies in Great Britain was made publicly available. The following statistical synopsis will be found to embody the more important features discussed:—

Guns, Rifles, Shells, etc.

Shells.—An output which in 1914-15 took twelve whole months to produce is now attained in Great Britain in the following periods:—18-pounder ammunition, 3 weeks; field howitzer ammunition, 2 weeks; medium-sized shell, 11 days; heavy shell, 4 days; or, lumping all kinds of gun and howitzer ammunition together, we are now manufacturing and issuing to France every week about as much as the whole pre-war stock of land service ammunition in the country.

Artillery.—Our present monthly output of big guns is about twice as many as were in existence for land service when the Ministry of Munitions started. The monthly output of heavy guns increased more than six-fold between June, 1915, and June, 1916, and will soon be nearly doubled.

Machine Guns.—The weekly output has increased, since the Ministry of Munitions was founded, fourteen-fold, and is still increasing. Soon we will have overtaken all the requirements of the British Army, and will then be able to turn our manufacture exclusively to supply our Allies.

Rifles.—Nearly three times as many new rifles were accepted in the first year of the Ministry of Munitions' activities as in 1914-15. The equipment of our army now overseas, both in machine guns and in rifles, has been accomplished from home sources alone.

Small-Arms Ammunition.—The home production is now three times as much a week as a year ago. We meet all demands made by the War Office, and yet have built up a stock for the future.

High Explosives.—The production is now 66 times as much as it was at the beginning of 1915.

Transport and Finance

The overseas transport of munitions has reached 1,300,000 tons.

There are now ninety-five National munition factories, and one of them fills twice as much as Woolwich.

Last year the United States supplied 70 per cent. of light shells; this year we shall make our own.

American heavy shell supply was invaluable, but it is hoped, with Canada's help, to be independent of it.

The finance department of the Ministry of Munitions controls an expenditure of $5,000,000 a day. Its supervision has saved $100,000,000 a year on shells; it has reduced American contract prices by 15 per cent.

Forty-five thousand soldiers have been recalled for munition work.

A year ago 1,635,000 persons were employed; to-day there are 2,250,000, and of these 400,000 are women.

REFRIGERATION DEPARTMENT

REFRIGERATING PLANT REGULATIONS

WITH the increased and increasing installation of refrigerating plants, large and small, not only in Canada, but the world over, it has become necessary for the public welfare, particularly in large cities where more or less congestion of residential, manufacturing and warehouse buildings exists, and in view of the fact that attendants may not have kept pace with equipment developments, to bring such establishments within the scope of some enactment—state, provincial or municipal, so that their operation be properly regulated. What follows embodies the regulations recently put in force by New York City, and these having been drawn up by the City Bureau of Fire Prevention along with a committee of the American Society of Refrigerating Engineers, it goes without saying that effectiveness of purpose is likely to be realized. The various clauses will be found to apply quite universally, and, irrespective of the enactment feature, the data given will be found instructive by operators generally.

Emergency Devices

1—All refrigerating plants of three tons refrigerating capacity or over, using ammonia or ethyl chloride as a refrigerating agent, shall be equipped with a device or devices for discharging the refrigerating agent under pressure, in case of emergency, into sufficient water to absorb all discharged gas and carry it off to the sewer; the device or devices to be constructed to conform with that recommended by the American Society of Refrigerating Engineers, March 20, 1916, as shown on Fire Department drawing. The Fire Department will have sole use of the device, and supply the necessary water.

2—No valves shall be located in the emergency discharge lines excepting the control and check valves to the water and refrigerant mixer, but there may be one control valve on each emergency line located near connection to main high and low pressure lines for repair purposes only. Such additional valves shall be kept open at all times, and if closed will constitute a violation of the intention of these regulations.

3—The emergency valves, and standard Fire Department Siamese connection shall be located on the public thoroughfare side of the building, either outside of building, or in a vestibule having glass panel doors which will provide easy access from the street, with valves at a height of not more than five feet above street or vestibule floor level. In no case shall the emergency valves be located over the exhaust outlet for ventilating the room containing the refrigerating plant. In large refrigerating plants, at the discretion of the engineer in charge, there may be installed pressure gauges on the high and low emergency lines for determining changes in pressure while emergency lines are operating.

4—The emergency valves shall be protected by a suitable box, and kept locked. The lock shall be opened only by a "Fire Department Inner Box Key" and only by members of the Fire Department. On the outside of the box there shall be painted in easily legible letters the words "For Fire Department Use Only." The high pressure emergency valves shall be labelled "High Pressure Ammonia," and the low pressure emergency valves shall be labelled "Low Pressure Ammonia." A sign reading as follows shall be posted in the box: 'Do Not Open Valves Until Water is Flowing. Maintain 50 pounds pressure."

Automatic Safety Valves

5—All refrigerating plants of three tons refrigerating capacity or over shall be equipped with an automatic safety valve or valves on each compressor or generator, which discharge at not greater than 300 pounds pressure per square inch for ammonia, 1,400 pounds pressure per square inch for carbon dioxide, 100 pounds pressure per square inch for sulphur dioxide or ethyl chloride. Such automatic safety valve or valves shall be connected to the "High Pressure Side," and may discharge to the "Low Pressure Side," as recommended by the American Society of Refrigerating Engineers, March 30, 1916, and shown on Fire Department drawing A. The discharge from the automatic safety valve or valves may be conducted by continuous piping to a point at least 10 feet above the highest opening in the roof of the building in which the plant is located; point of discharge above the roof to be located as remote as practicable from horizontal openings in surrounding buildings. Where ammonia is the refrigerating agent, the discharge end of the pipes shall be equipped with a diffuser designed to mix the gas with the air without restricting its flow.

6—On carbon dioxide plants, in addition to the heretofore mentioned automatic safety valve at the compressor, there may be an automatic safety valve located on the high pressure and on the low pressure sides, as a substitute for the emergency device shown on the Fire Department drawing A. The points of connection for such automatic safety valves shall be located as indicated for the emergency discharge lines. The outlet from such automatic safety valves may discharge into engine room or to outer air.

7—Maximum Pressure Allowed

Refrigerating Agent:	Pressure.
Ammonia	300 lbs. per sq. in.
Carbon dioxide ..	1,400 " " " "
Sulphur dioxide..	100 " " " "
Ethyl chloride ..	100 " " " "

8—All pipes used for refrigerating purposes shall stand a hydrostatic test of at least double the maximum pressure per square inch specified in Section 7, and all fittings shall be guaranteed to stand a pressure of at least three times the maximum pressure per square inch specified in Section 7. All gauge glasses shall be adequately protected, and provided with shut-off valves.

General Plant Definitions

9—Refrigerating machinery rooms are rooms in which are located compressors, generators, condensers, receivers, absorbers or other apparatus necessary to produce or contain the refrigerating agent. Rooms which contain only the refrigerating chemical supply pipes to and from the refrigerating coils are not considered refrigerating machinery rooms, but such rooms, if occupied by any persons, must comply with the requirements as to exits hereinafter described for refrigerating machinery rooms.

Lights, Flames, Boilers

10—In all refrigerating machinery rooms in which ammonia or ethyl chloride is used, there shall be no flames, arc lights, gas jets or any apparatus employing flame, except internal combustion engines with internal ignition, which may be started in the usual manner.

11—All refrigerating machinery rooms shall be separated from other parts of the building by tight partitions and tight self-closing doors, and from boilers by tight fireproof walls unpierced, except by openings protected by tight self-closing fireproof doors or stationary fireproof windows.

Exit and Ventilation

12—All refrigerating machinery rooms shall have a direct exit to the open air or to a room or hall from which gases can be excluded by self-closing doors.

13—Vertical and horizontal openings that permit the passage of gases to other parts of the building, which are not a part of the refrigerating plant, shall be sealed, or provided with self-closing doors.

14—All refrigerating rooms shall be provided with adequate ventilation to the open air, either direct or by means of a suitable duct or ducts. Where a mechanical system of ventilation is employed, control of the system shall be located at a point easily accessible.

Filing Plans

15—Plans shall be filed for structural changes only. Alterations made necessary to meet the requirements of these regulations shall comply with the Building Code.

Designation of Pipes

16—All pipes containing a refrigerating chemical under pressure shall have conspicuous signs attached to them at proper places designating in easily legible letters the name of the chemical contained therein. The signs shall be placed on each main supply and suction pipe in each room. Valves which control main sections of refrigerating system, and are necessary to separate such sections in case of emergency, shall be labeled.

Rules

17—In all refrigerating plants there shall be posted several copies of a brief set of rules, satisfactory to the Fire Commissioner, directing all employees as to their duties in case of fire or other emergencies. Employers shall be responsible for the proper drill of all employees in such emergency duties.

Helmets

18—All large refrigerating plants shall be provided with helmets of approved type, which will permit the wearer to reach, without suffocation, any part of the refrigerating system. In plants of 25 to 75 tons refrigerating capacity there shall be at least one approved helmet, and in plants of greater capacity than 75 tons there shall be at least two approved helmets.

19—These helmets shall be kept in a suitable case or cabinet of easy access, preferably outside of refrigerating machinery room or near doorway leading therefrom.

Surplus Refrigerating Storage

20—Refrigerating plants may store a surplus stock of the refrigerating chemical of two cylinders, or, if necessary, a quantity not to exceed 10 per cent. of the charge of the plant. This surplus chemical shall be stored in a cool place.

Certificate of Fitness

21—No refrigerating plant of over three tons refrigerating capacity shall be operated unless under the charge of a person holding a certificate of fitness from the Fire Commissioner, or who has been duly certified as competent to operate a refrigerating plant by any department of the City of New York having jurisdiction to certify thereto. A certificate of fitness will be required of each person who is directly in charge of the operation of the refrigerating machines.

Plants Under Three Tons Capacity

22—The Fire Commissioner may exempt from the provisions of these regulations, except the provisions referring to flames and exits, refrigerating machines of less than three tons capacity, provided a certificate of approval has been issued for such machine.

Permits

23—It is unlawful to operate within the City of New York any plant producing refrigeration by means of gases and pressure in connection with cold storage plants, breweries, ice manufacturies, restaurants, or other places, without a permit. The application for permit must state the refrigerating builder's rated capacity in tons, the kind of chemical used, the amount of surplus chemical stored, the number of shifts, and time the plant is operated during a period of 24 hours.

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WESTINGHOUSE-LEBLANC WATER VAPOR REFRIGERATING MACHINE.

In the course of a paper describing the principal characteristics of the Westinghouse-Leblanc Water Vapor or Vacuum Refrigerating Machine, J. C. Bertsch, the author remarked that a special feature of the apparatus was that the substance to be cooled, whether water, brine or other liquid, was cooled within the mechanism by the evaporation of a part of the substance. This was of great importance where concentration and cooling were both desired, as was often the case in dairies, sugar refineries, breweries and chemical works. For temperatures above 35° F., water is used as the medium, and below this brine is used. The commercial Westinghouse-Leblanc refrigerating equipment consists of ten parts. The surge tank, serves to maintain a constant volume of brine in the apparatus, and when, by evaporation, a loss of water occurs, fresh " make up" water is supplied through the float valve fitted. The evaporator is divided into two parts; through the inner part the brine is caused to fall in a fine spray. The high vacuum in the evaporator raises the brine from the surge tank in which the pressure is atmospheric. The high vacuum in the evaporator causes water to evaporate from the brine spray and cools it.

Ejector Feature

The most important part of the whole apparatus is the ejector. This consists of two parts, the steam nozzles for the transformation of potential (the pressure and a part of the heat energy), into kinetic or velocity energy, and the diffuser for reconverting the kinetic energy into potential or pressure energy. The steam nozzles consist of a number of De Laval type nozzles, the same as used on the De Laval turbine. Issuing from the ends of these nozzles the steam has a velocity of from four to five thousand feet per second. With a cluster of these nozzles an enormous suction is produced which draws the vapor from the evaporator. The steam, with its high velocity, entrapping the vapor to be removed, becomes compressed and its velocity retarded in the diffuser. For a refrigerating effect of 50°, one ejector is used, but if a greater temperature difference is required two ejectors in series are used.

To condense the steam either a jet or surface condenser may be used. The condensed steam and any air which has leaked into the system are discharged by the Leblanc air pump. The pump has sealing water between its rotating blades which, upon being discharged in slugs at high velocity, entrap any air and remove it from the system. The water in the sealing water tank, is used over and over. A cooling water circulating pump and a cooling tower are other constituents of the equipment. The prime mover may be any high-speed prime mover, preferably a steam turbine or electric motor. With a turbine the exhaust steam can be used in the ejector. A brine circulating pump, completes the already-mentioned ten main component parts.

Claims made for this type of refrigerating apparatus are that it requires practically no foundations, takes less floor space and less building space than any ammonia compression or absorption system, and in large units its first cost is considerably less than any other system. The wear and tear on the apparatus is also claimed to be small, as only three pumps of the centrifugal type, constitute the moving machinery. Also, no chemicals are used and the cost of recharging is nil. No pressure higher than atmospheric is used and there is no danger of explosion. Either exhaust steam from engines or other steam appliances can be used, but the steam must be perfectly dry, as water injures the efficiency of the nozzles.

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PAPER SHORTAGE AND COST EFFECTS

THE publishing business in Canada and elsewhere is facing a serious crisis. Since the first of the present year there has been a growing scarcity of paper and a corresponding advance all along the line in prices. During that period the best grades of paper—white coated, have gone up fifty per cent. A medium grade of coated paper which cost 6 cents per pound previously cannot now be bought for less than 9 cents; and the mills are dodging orders at any price. Super-calender paper which formerly sold at from $4.35 to $4.50 is now quoted anywhere from $7.00 to $8.25. Newsprint—the rough surfaced paper on which newspapers are printed—has advanced nearly fifty per cent. Many of the best grades of paper have been taken off the market altogether, the manufacturers finding it impossible to keep up the quality. There is, in fact, a very general depreciation in paper quality despite the staggering jump in prices, and, notwithstanding the latter, manufacturers are being compelled to refuse business or to defer shipments for long periods.

This condition is operating in two directions in its bearing on the publishing business. It is forcing publishers to economize on paper in every conceivable way. They are finding it necessary to reduce the number of pages printed. Lavish supplements, containing features whose scope of appeal is limited, have had to be excised. "Extras" are put out only when the news really warrants it. Newspapers, magazines, class papers, are all concentrating on the important problem of printing the really essential matter in the least space and eliminating all non-essentials. In this one respect, the paper shortage will prove a blessing in disguise. Publishers are examining their mailing lists closely, cutting off unprofitable "exchanges" and "dead heads" and are doing everything in their power to economize in other similar directions. In these days of scarcity only the man who wants his paper sufficiently and is willing and ready to pay for it promptly should get his copy.

The situation is reacting in another direction. It is forcing publishers to raise their subscription rates; many newspapers and class publications have already done so. Subscription rates in Canada have, in the past, been hammered down to a more or less ridiculous minimum by strenuous competition, but now it is clearly impossible for publishers to continue to supply their product at such low prices in face of the sudden advance of paper cost.

The reader should bear the foregoing facts in mind. If he is inclined to complain when his favorite periodical comes to him a little thinner, and when his renewal notice quotes a higher figure, let him pause to consider that it is only by such measures that the publisher is able to continue to send him the paper at all.

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BRITAIN'S WAR ENGINEERING ACHIEVEMENT

IT is impossible, even from the most cursory perusal of the data embodied in the recent speech in the British Parliament by the Minister of Munitions—a synopsis of which appears in this issue, to feel otherwise than satisfied, not only with accomplishment to date as regards variety, type, quality and quantity of our munitions production and its contributory accessories, but to be disposed to look forward to continuous and still greater achievement as each succeeding day unfolds itself. The comparisons made—whether these be taken from a peacetime establishment point of view or from the period covering the early months of the conflict, bear an almost miraculous interpretation in the light of the knowledge now available. Not only is a master hand apparent in the mobilization, in the first instance, of our industrial resources, and more particularly those relating directly to engineering and metalworking, but the latter themselves in the spheres of management and operative skill have mobilized in no less degree a creative genius, and have given same a practical exemplification without parallel perhaps as to either time or place industrially.

Since the data referred to became public property, a clearer vision of the ultimate outcome of the struggle has been secured, and not only so, but an added inspiration has been given our people to persist in their meantime war-directed effort. It is also gratifying to note that our Ally, France, is in the same happy position as ourselves as regards munitions output, and that in her case too, the limit of achievement is still being extended. Side by side with our munitions production, may be placed that of our warship building and fleet maintenance, in which latter respect it may be said that we are even more comfortably circumstanced. Just what our naval strength is now is more or less of a profound secret, however, we know that peace time or early war month comparisons are equally disproportionate with those of munitions production. Although our fleet strength has been procured at what may be termed the expense of our merchant shipbuilding, evidences now point to a relaxation regarding the former, and to a transfer of energy and effort to the latter. That conditions are such as to warrant this step is particularly gratifying.

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THE QUEBEC BRIDGE TRAGEDY

IF we might so express it, misfortune appears to dog the effort to bring to completion the work of spanning the St. Lawrence River by what is known as the Quebec Bridge. In spite of the elaborate arrangements made and the most carefully and skilfully devised precautionary measures taken, to "make North and South Shore ends meet," disaster supervened, with the result that the centre span or that piece which would have joined shore to shore now lies at the river bottom. This much may be said, however, regarding the method of procedure adopted—ultimate successful accomplishment of the object in view had begun to demonstrate itself ere misfortune overtook the effort.

The Operators' Point of View

GRINDING BRASS VALVES

By D. A. Hampson.

WITH the automobile came valve grinding on such a scale that it has been brought home to most mechanics who, if told to grind in any kind of a valve, would straightway start the work with emery and oil or one of the various compounds of these. There is, however, a class of valve grinding met with in shops of supply manufactures and in certain branches of repair work that is quite different and little known outside of these lines. In this class are pet and stop cocks, valves used on bar and restaurant fixtures, shut off cocks for house water systems, and valves used in bottle filling work in various kinds of food production and packing.

All of these "valves" have a cylindrical core turned to a taper of approximately one inch to the foot and fitting in a body reamed to the same taper. The core is held to its seat by a D washer and nut at the small end. The material is cast brass of the best grade.

In the manufacture of these valves the taper of the two parts is made to correspond exactly, thereby reducing the amount of grinding; in repair work, circumstances may compel all the re-fitting to be done by hand grinding or grinding after awkward shaped pieces have been machined, perhaps none too well because of their shape.

Grinding is imperative—a perfect fit cannot be secured in any other way—for liquids such as gasoline, the familiar lead pencil mark and other visual tests, are not good enough, and the valves are tested by suction. In manufacturing this is done by applying the valve to a quick acting connection on the shop vacuum system—if the valve holds its weight, it is ready for any service—and a corresponding test for heavier valves. On a repair job the rather unsanitary method of testing is to put one of the connection ends in the mouth, close the lips tightly around it, and with a deep inward breath place the tongue over the opening. If the tongue is held fast, the valve is sure to be tight — tight enough for gasoline. Another less positive way is to oil valve and core and then blow in the connection looking for bubbles at the joint as an indication of a leak.

Sand is by far the best grinding medium for brass valves; emery or corundum should be used only when no sand is obtainable, for it is well nigh impossible for even a skilled grinder to keep from scoring the surfaces—something impossible with sand of the right kind, though the greenest boy in the shop does the work. White sands are used for valve grinding—sea sands or certain sands produced by glacial action—dry, sharp, and free from loam and vegetable matter. In general, any sand which is good for locomotive work will do for valve grinding.

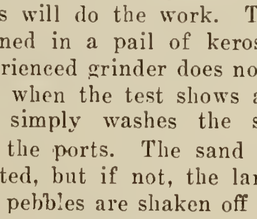
The valve grinder oils the core, rolls it in sand and thrusts it, coated, into the valve. The actual work is as with any valve—turning the core through a small arc, shifting to another position and repeating with additions of oil as the work gets dry. Any of the common shop oils will do the work. The parts are cleaned in a pail of kerosene and the experienced grinder does not remove the core when the test shows a perfect seat, he simply washes the sand out through the ports. The sand is better used sifted, but if not, the larger particles or pebbles are shaken off after the oiled core is rolled in it.

* * *

A TAPLESS BARREL

By J. E. Noble

THE enclosed sketch shows how a barrel can be used without a tap. Stand the full barrel on end, bore a hole in it making a tight fit for a ¾-in. nipple. Slip a rubber washer over the nipple and screw on the locknut A. Place another rubber washer on over the nipple and screw on the elbow D. Now screw on the pipe B, and lower the barrel C on its support leaving the pipe B upright as shown.



A TAPLESS BARREL.

To draw off oil or any other liquid, simply lower the pipe to the side until the liquid runs out the end. To stop, raise the pipe. If gasolene is the content, a cork should be placed in the pipe end when not in use This wrinkle is O.K., there will never be a drip, as raising the pipe stops that, and the washer between the elbow and locknut prevents any chance of a leak there, however if gasolene is the contents a leather washer should be used instead of rubber.

* * *

EVERY MAN TO HIS OWN TRADE

By R. J. M.

THERE are very few men who have not, at some time, been placed in a position of humility, on finding they were forced to relinquish a task they had at first considered as very simple. It seems to be a trait of human nature to think itself capable of performing certain tasks, as well, if not better than the other fellow, who in many instances has spent several years of his life in acquiring the necessary knowledge for the successful accomplishment of his alloted duties.

Some years ago, while working in a jobbing shop, I was turning the outside of a large cylinder, about 30 inches long. When noon hour arrived, there remained a portion of about one inch to complete the cylinder and as I would not be on hand in the afternoon, I disengaged the feed but left the tool in position, expecting to rough off the remainder in the morning. Upon my return I noticed that a portion about ⅜ inch long had been very roughly torn off. Upon making inquiries of one of the men, I learned that the office superintendent had endeavored to complete the job, with the above result. His effort proved very discouraging, for he finally left off and returned to the office.

Under ordinary conditions, he might have achieved his purpose, but as this particular lathe was badly worn, it required careful handling for satisfactory results. To start a cut, it was necessary to take up all the slack in the apron gears before engaging the friction feed, and even then it would be some little time before the saddle would commence to move. As these conditions were not known to the "Supt.," he had tried several handles with no apparent result, finally trying to finish the cut by feeding with the hand wheel.

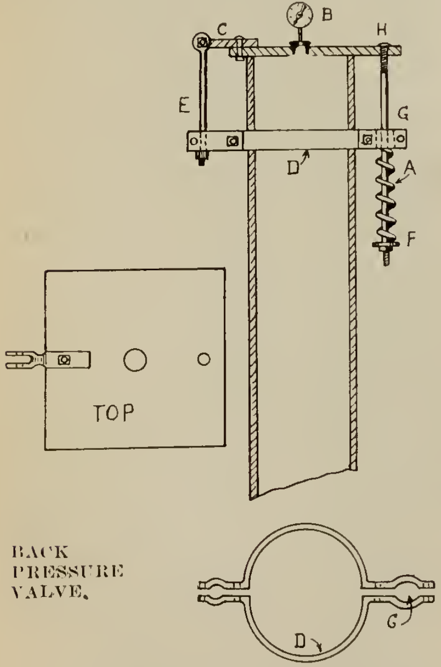
Another case of mistaken ability was that of a preacher, who anticipated, without much trouble, making a joint in a water pipe connection. Having obtained an ordinary flat faced union and a quantity of red lead from an engineer next door, he started in to do the "little" job. A few hours later, the engineer was called in for advice, to find the preacher covered from head to foot with red lead and perspiring freely in an effort to stop the joint from leaking. The engineer looked at the job, shut the water off, released the union with great difficulty, as the other had been using brute strength (pardon the expression) in trying to get a tight joint, inserted a rubber gasket, replaced the nut, and when the water was turned on, no leak was evident. The preacher thanked the engineer, but what was said before his appearance is not recorded.

* * *

BACK PRESSURE VALVE

By J. Thorn

THE back pressure valve shown was used on top of a 6 in. exhaust pipe from a steam engine, the strap D fits tightly around the exhaust pipe and bolt E. There is a long loose hole at G, for the bolt to work in. The joint C is pivoted so that the lid or top can lift, thus compressing the spring A. A large washer is on the bolt at F to hold the spring in place. To set the valve attach a low pressure gauge at B and screw up the nut at F until the top lifts at the required pressure. The end of the bolt is riveted or screwed in tightly at H. When the valve is set remove the gauge and bushing from the hole at B, this hole, should be about 1 in. dia. so that there will always be an opening to allow air and a certain amount of steam to escape at all times. Otherwise the valve might become set by frost in the winter but with the hole open it will give satisfactory service winter and summer. As the pressure required will rarely exceed 5 pounds to the square inch all that is required is a light piece of iron plate, or even a piece of 1¼ in. wood board, for the cover, but in the latter case the spring may have to be reset when the wood becomes water soaked, although it will amount to very little.



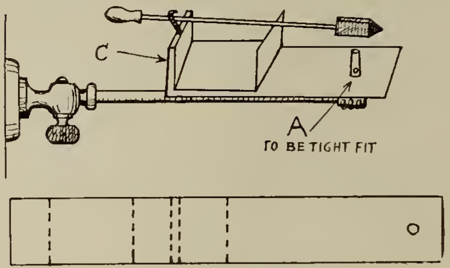
BACK PRESSURE VALVE.

* * *

SIMPLE HEATER FOR LIGHT SOLDERING IRONS

By J. E. Noble

TAKE a strip of tin, make a hole in one end and fold it at the dotted lines as in Fig. 2, to the form shown in Fig. 1.



FIGS. 1 AND 2. SIMPLE HEATER FOR LIGHT SOLDERING IRONS.

Remove the gas tip from the burner tube and file a hole in the tube, as at A or use the shank from an upright mantle burner, force a narrow piece of wood in at C. Punch a small hole in the tin at B, and screw in the hook. This holder will remain on an ordinary gas bracket and can be slipped on or off in a few seconds.

* * *

LEATHER VS. SUBSTITUTE BELTING.

By N. G. Near.

I WAS interested in this sentence, page 189, of The Power House: "Woven belting—is never likely to displace leather in the estimation of a host of engineers." Perhaps the wish is father to that thought, and, per father to that thought, and, perplaced in all fields of its use. Yet it is a fact that in several fields the leather belt is practically eliminated.

In the operation of a clay plant, for instance, it has been found that canvas and rubber belts are giving better service for the money than leather belts, besides the workers in those plants find it more difficult to keep the leather belt clean. On main drives, though even in these plants, in the cement field, and elsewhere, the leather belt still seems to have preference, but the fact that the substitute belt is endeavoring to put the leather belt out of business is worthy of note.

Doubtless the main reason for the rise of the substitute belt is cost. Leather is going up, and up. The price of substitute belting, although rising, isn't rising so rapidly, so, even though the substitute may not last long, it will be used if it will prove as efficient in transmission and if it can be shown that each dollar thus invested will produce more returns than each dollar invested in leather belting. These things are not easy to prove, but, experience seems to be teaching us that in all fields leather is not always the most economic selection.

* * *

COMPRESSOR SPEED.

By C. T. R.

THE proper speed for an ammonia compressor cannot be accurately figured out theoretically. Were it possible, however, the capacity of the machine would vary directly as the speed; that is, a 5 per cent. increase in speed would give 5 per cent. increase in refrigeration work performed, because a proportionately larger volume of gas would be handled. In practice, however, there is a maximum speed for higher capacity governed by the size of the suction and discharge valves and the length of the stroke.

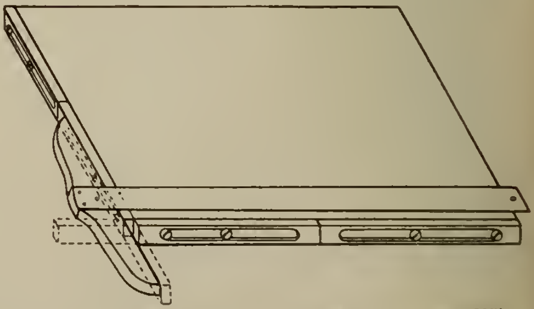
The proper speed can best be found by a test of the particular machine, keeping the speed constant for a period of five days. Record all the ice that can be pulled during the last forty-eight hours of test. Change the speed materially (at least seven per cent.) and repeat test. Compare the ice pulled during the last forty-eight hours of this test with the previous one. Suction pressure, condenser pressure and other conditions should be uniform for these tests, and these can be regulated by adjusting the expansion valve, cooling water, etc.

* * *

HOLDING THE TEE-SQUARE STRAIGHT.

J. E. Cooley

WHEN using the tee-square near the edge of the drawing-board, so that part of the head of the square extends beyond the latter, it is quite difficult to hold the square straight and draw the lines true, as the least little pressure of the drawing-pencil against the straight-edge of the square causes it to wiggle especially at its outer end. Many



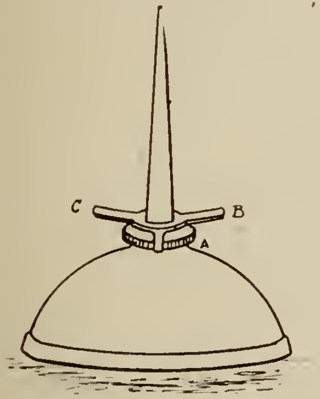
HOLDING THE TEE SQUARE STRAIGHT.

drawing-boards have two steel straightedges that are fastened on the left-hand **and lower side of the board.. If these** are sawed in half and an elongated slot is made in them as seen in the illustration, they can be moved so as to extend beyond the edge of the board, and thus give a firm support or bearing along the entire length of head on the tee-square.

OIL-CAN CLIP.

By J. E. C.

A GOOD deal of awkwardness is displayed in the act of picking up an oil-can, because there is no convenient means of taking hold of it properly. Often in attempting to pick one up, it slides away or falls off the machine to the floor. An oil-can should be so arranged that it can be easily clutched and used on the instant. By this is meant, getting a hold with the index and fore-finger under the spout, and the thumb below the base to squirt the oil. Usually however, on most oil-cans the space between where the spout is screwed to the can, as at A, is so narrow there is no possibility of doing this. If a small clip is made as shown, the oil-can can be picked up without any trouble. The clip is made from sheet-stock inserted over the spout through the hole, and two sides are folded under the knurled edge as shown. The two projections C and B extend out just far enough to get a sufficient hold with the index and forefinger.



OIL CAN CLIP.

LIFTING CENTRE SPAN OF QUEBEC BRIDGE.

ALTHOUGH through an unforeseen eventuality, disaster instead of success attended the raising of the centre space of the Quebec Bridge to its permanent location on September 16, a brief account of the power equipment arranged and installed for the carrying out of the project will we believe have more or less interest for our readers, particularly as the whole subject is appropriating meanwhile their special attention .

The method adopted for elevating the central span, from the pontoons to its final positions was by means of eight 1,000 ton hydraulic jacks, two of which were located at each corner of both cantilever arms and supported on specially designed girders hung from the upper chord of each main structure. On the lower end of these hangers there was a special fixed girder which contained two hydraulic jacks, the plungers of the latter pressing against the moveable girder located directly above. The arrangement of the mechanism was such that the lifting strain was always on the lower member of the supporting girder, being taken directly through the connecting pins when in a stationary position; and indirectly through the jack when the weight was being raised.

The working lift of the jacks was two feet. Three holes for the 12-inch diameter locking pins were located 24 inches apart in the special girders; the corresponding holes in the hanger chains being placed six feet apart; this provided for a lift of 2 feet at each operation of the jacks. The hanger chains, made in thirty foot lengths, were composed of two plates 30 inches wide and 2¼ inches thick. With calculations based on a start being made at full tide, the 70 cycles required to lift the span 140 feet were expected to take about 16 consecutive hours of actual operation. The exact time was however, only problematical, as it was altogether dependable upon the speed at which the hydraulic pumps could be operated by compressed air, with the addition of other possible contingencies.

To provide for any emergency thrugh the failure of any of the hydraulic jacks, etc., large screw jacks were located on the inner side of each supporting girder. These screw jacks, each 12 inches in diameter, were not to be used to facilitate the elevation of the suspended span but were for the purpose of constant adjustment by hand to the increasing space, as each separate lifting operation progressed. Platforms were constructed adjacent to the link connections for the workmen operating the locking pins and emergency jacks.

Power Equipment

The hydraulic equipment necessary for the operation of the lifting jacks was located at the outer end of each cantilever arm. The cylinders of the jacks were steel castings 22 inches inside diameter, and 33½ inches, outside diameter with rams of chilled cast iron. The pumps were of direct acting plunger type, and were operated by compressed air, supplied by compressors located on the shore at either end of the main approach. Air was delivered to the pumps at a pressure of 100 lbs. per square inch; the pump cylinder were 18 inches in diameter, and the water plungers of 2 inches diameter. Pumps, jacks, and all piping connections had been tested to 5,000 pounds pressure, but the actual working pressure was not expected to exceed 4,000 pounds per square inch. The installation was so designed that a uniform pressure would be maintained upon all four cylinders, to insure equalization of stress at the various points of support. Provision, however, was made by an ample installation of balanced valves in the pipe line to control any particular unit.

PACKINGS FOR SUPERHEATED STEAM

MOST of the packings used in England for steam jointings have been in the past made abroad, and in consequence of the difficulty of obtaining supplies, several British firms have been endeavouring to make in that country packings of equally good quality. The chief difficulty has been to obtain packings which can be used for joints in superheated steam pipes. Several samples have been tested in the apparatus for testing the blowing-out pressure of joints at the National Physical Laboratory, and according to the report of that institution, the makers have been so far successful in producing joint rings varying from 1-32-in. to ⅛-in. in thickness which will stand a pressure of 250 lb. per square inch at a temperature of 1000 deg. Fah. to 1100 deg. Fah., without any signs of breaking down.

* * *

STAINLESS steel is expected to be the subject of great developments when Sheffield manufacturers are enabled to devote more time to its applications. Where steel is subject to the influence of earth and water this new material will be widely adopted, and in many cases of machine shop equipment its use will be welcome. Machinists' fine tools offer a wide field for its use, steel tapes and scales being also suitable for production in this material, the possibility of making these latter articles having been proven by the successful manufacture of stainless wafer blades for safety razors.

* * *

Wrinkle for hot boxes.—Get a cake of Sapolio and scrape a little of it (fine) into a tin, mix with some water and pour into the bearing while the machine is running. Let it run a few minutes, then give it some oil, and you will find that you have a nicer bearing than you could scrape, and it does not hurt the shaft any.

Operators' Instruction Course

CONCERNING INDICATOR DIAGRAMS—I.

THERE is perhaps no device of such incalculable value, so simple in construction, and easy to apply, which is less understood and as little appreciated as the steam engine indicator. The latter has probably had more influence upon the development of the modern steam, gas and oil reciprocating engine, and gas compressing machines than any other factor, and has enabled designers to bring out the present-day improved types of valves and governors. It is an indispensable tool of the engine builder and erecting man for the final adjusting of valves and tuning up of the engine for the highest efficiency operation.

General Uses

Since adjustments of an engine in operation are not permanent, and conditions affecting the engine economy and output are subject to change, frequent readjustment is required. For this reason no modern operating engineer can afford to be without an indicator. The indicator shows whether or not the valves on the engine are set for the best possible steam economy, and it not infrequently happens that a few minutes' work in readjusting the valves will result in reducing the steam, gas or oil fuel consumption of an engine as the case may be, 25 to 50 per cent. for a given load. The indicator further shows the power developed in the cylinder, indicates piston and valve leakage, excessive cylinder condensation, excessive pressure drop from boiler to engine and proper distribution of load between cylinders of multiple cylinder engines.

Indicator First Cost

Considering steam in the ordinary industrial plant as worth anywhere from 20 to 50 cents per 1,000 lbs., it is readily seen that the cost of an indicator is insignificant as compared with the saving in money incident to rectifying and reducing the steam consumption of an engine a few pounds when figured out for an engine operating 10 to 20 hours a day throughout the entire year. The real dollar and cents value of owning an indicator is the means that it affords of immediately showing results in increased efficiency and economy, thereby making the engineer a more valuable and better paid man. Again, from the use of the indicator, he will learn more about steam engines in a short time than by many nights of study.

Steam Users' Attitude

Indicator diagrams receive comparatively little attention from steam users generally. In cases where indicating gear is provided, it is very frequently looked upon as a useless adornment of no practical use, and even where it is occasionally used, the cards obtained are looked upon merely as giving an indication of the power exerted in the engine. The quantity of coal burnt under the boiler in a given time is then ascertained and a statement made that the engine is developing so many horse-power with a consumption of so many pounds of coal per hour; it is therefore developing power at the rate of so many pounds of coal per horse-power per hour. Although this is the ultimate test of the efficiency from a commercial point of view, the fallacy of the calculation, as above, is that it does not distinguish in any way between the efficiency of the engine and the efficiency of the boiler, so that a good engine worked in combination with a bad boiler, or a good boiler set badly, may give exactly the same result in pounds of coal per horse-power per hour, as a bad engine worked in combination with a thoroughly good boiler.

Engine Cylinder Work Record

Beyond enabling the observer to ascertain the power developed by the engine, however, the indicator diagrams when properly taken, studied, and understood, contain a great deal more information, and give practically a complete record on paper of what actually takes place in the engine cylinder when at work.

Thus wire-drawing of the steam due to the insufficient size of steam pipe, restricted passages in stop valve, throttle valve or ports, are at once made evident; incorrect setting or design of steam or cut-off valves, leaky pistons or valves, throttled exhaust pipes or passages, insufficient or excessive compression, are all shown; and by an analysis of the expansion curve—which, by the way, requires very considerable knowledge and care, both arithmetically and geometrically—wet steam, condensation, and sometimes re-evaporation, can be detected. All these mean losses in efficiency, each of them possibly small in themselves, but as engine economy is made up of a large number of small items, when they are added together the result becomes very appreciable.

Check on Valve Setting

The more nearly the steam admission curve up to the point of cut-off follows a horizontal line at or near the boiler pressure, and the more closely the expansion curve follows the theoretical curve—that is, one in accordance with the law of gases, as laid down by Marriotte, viz., that the volume varies inversely with the pressure—the greater will be the economy on the steam side of the piston. The exhaust side is also well worth study, as to make the engine work with the greatest smoothness and economy, the exhaust valve must, equally with the steam valve, open at exactly the right place, and the more quickly after the exhaust valve is open the pressure falls to the nearest possible point to that of the atmosphere, if working high pressure, or to the vacuum line if working condensing, and the more nearly by closing the exhaust at the proper instant the compression curve can be brought up at the end of the stroke to the initial pressure of the incoming steam for the next stroke, the more smoothly and economically will the engine work.

Economy thus obtained does not mean a saving in steam alone and keeping down the coal bill, but also means small costs for repairs, regular speed, absence of breakdowns, easy lubrication, and the least possible loss from depreciation, and consequently longer life of the engine and machinery. The indicator diagrams show at once if an engine is over or under loaded (both being highly uneconomical conditions of working), and a careful study will enable one to decide on what steps to take to improve the economy and reduce the steam and fuel consumption.

Engine Friction Demonstrated

Another very important feature of the indicator diagram from an economical point of view is that it enables us to ascertain what power is taken up in driving the engine itself, what is absorbed in driving various parts of the gearing and machinery, and what remains available for doing work. These are very important points, as it frequently happens that 20 or 25 per cent. of the power developed in the engine cylinder is absorbed in driving the engine itself, another 30 or 40 per cent. being taken up in the gearing, shafting, etc. The indicator diagram is really the only means by which these many and various points can be graphically recorded, and in order that it may be of value it must be very carefully and accurately obtained and worked out.

Indicator Mechanism Delicate

The indicator is a very delicate instrument and requires handling with the greatest care, and it must be properly adapted for its purpose. For example, an instrument well adapted for taking diagrams of a low pressure slow-speed engine, is perfectly useless for a high pressure quick-speed engine, and very frequently considerable skill and ingenuity must be brought to bear in making the attachments. The length of the connections, the arrangement of the levers, the inertia of the instrument itself and other points all have a very important effect on the diagrams produced, while the reducing motion employed must be such that it will give to the card an exact reproduction, on a reduced scale, of the motion of the piston. All this, of course, means money; but it is usually money extremely well spent, as the cost of the investigation is generally saved many times over in the course of a year.

The shape of the figure traced upon the indicator card depends altogether upon the manner in which the steam pressure acts in the cylinder. If the steam be admitted at the beginning, and exhausted at the end of the stroke, and admission continue from one end to the other, the shape of the diagram is nearly rectangular. If the admission continue through only a part of the stroke, the diagram assumes a shape similar to that of Fig. 1. These two representative forms have, in matters of detail, numberless modifications.

Essential Features of Indicator Diagram

Fig. 1 has been taken to illustrate the essential features of the indicator diagram, because it exhibits clearly all the operations affected by pressure that commonly take place in the steam engine cylinder. This diagram shows that the admission of steam commences at A and ends at D; the cut-off commences at C and becomes complete at D; expansion occurs from D to E; the release or exhaust begins at E and continues to the point H; the compression of the exhaust steam commences at G and ends at the admission point.

The line A B is called the admission line; B C, the steam line; D E, the expansion line; F G, the exhaust or back pressure line (or, in the case of condensing engines, the vacuum line); H A, the compression line; and J I, the atmospheric line. The curve which joins two adjacent lines, represents the action of the steam when one operation changes to another and cannot properly be classed with either line. The point of cut off, D, lies at the end of admission; the point of release, E, at the beginning of the exhaust, the point of compression, H, at the end of the exhaust. The proportion of the whole length of the diagram borne by the distance of the point D from the admission end, represents the proportion of the stroke completed at the point of cut off; so also in the case of the point of release, and in that of compression for the uncompleted portion of the stroke. The pressures at the points of cut-off, release and compression are the heights of these various points above the atmospheric line measured on the scale of the spring.

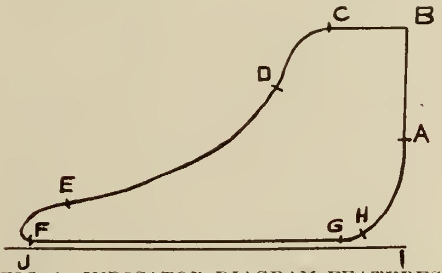


FIG. 1. INDICATOR DIAGRAM FEATURES.

Indicator Applications and Purposes

There are three main objects for the determination of which the indicator diagram may be employed: 1, to serve as a guide in setting the valves of an engine; 2, to determine the indicated power developed by an engine; 3, to determine, in connection with a feed-water test showing the actual amount of steam consumed, the economy with which an engine works.

1—Fig. 1 shows the general features of a well formed indicator diagram, the attainment of which should be the aim in setting the valves of an engine. The admission of steam is prompt, making the admission line perpendicular to the atmospheric line; the initial pressure is fully maintained up to the point where the steam begins to be cut off; the somewhat early release secures a free exhaust and a uniformly low back pressure, and the exhaust valve closes before the return stroke is completed, providing for compression. These are the first requirements to be met in producing an economical engine.

Derangement of the valve gearing is revealed in the diagram by tardy admission or release, by low initial pressure or high back pressure, or by absence of compression, either one of which causes an increased consumption of steam for performing the same amount of work. The angular position of eccentric controls all the movements of the valves, but improper lengths of the rods which operate them, or improper proportions of lap and lead, are liable to produce some of the faults we mention, as will also a wrong position of the eccentric.

Exhaust Regulation

In regulating the exhaust of an engine, the desirability of employing compression should not be overlooked. In the first place, it serves to overcome the momentum of the reciprocating parts and to reduce the strain upon the connections caused by the sudden application of the pressure at admission. In the second place, compression is desirable on the ground of economy in the consumption of steam. It fills the wasteful clearance spaces of the cylinder with exhaust steam, otherwise requiring the expenditure of live steam from the boiler. Compression produces a loss by the increased back pressure which it occasions, but the loss is more than covered by the gain resulting from the reduction of clearance waste.

Hypothetically, the greater amount of exhaust that is utilized by compression, the less the consumption of steam. Practically, it is not advisable to compress above the boiler pressure. If a non-condensing automatic cut-off engine with 3 per cent. clearance working at 75 lbs. boiler pressure, cut off at one-fifth of the stroke, and exhausting under a minimum back pressure, the gain produced by compressing up to boiler pressure over working under the same conditions without compression, should be not less than six per cent. In a condensing engine, working under similar conditions, the gain should be larger. It should be larger, also, with an earlier cut-off.

Steam Pipes and Passages

The valves being in proper adjustment, the indicator diagram shows whether the pipes and passages for the admission and exhaust of the steam are of sufficient size. In automatic cut-off engines the steam line should be parallel with the atmospheric line, and the initial pressure should not be more than 3 lbs. less than the boiler pressure. The back pressure should not in any engine exceed 1 lb. when the exhaust proceeds directly to the atmosphere. Much can often be learned by applying the indicator to the steam and exhaust pipes, using the same mechanism for driving the paper drum as that used when the indicator is operated at the cylinder

Before making adjustments upon engines that have been long in use, the operator should ascertain whether a valve which should travel to a different point has worn to a shoulder upon its seat. If changed under such circumstances, loss from leakage may follow, sufficient in amount to neutralize the saving that might otherwise result. This is a matter of much importance.

Indicated Power Determination

2.—The indicator finds a second use in determining the amount of power developed by an engine. The diagram reveals the force of the steam at every point of the stroke. The power is computed from the average amount of this force, which is independent either of the adjustment of the valves, the form of the diagram, or of any condition upon which economy depends. The diagram gives what is termed the indicated power of an engine, which is the power exerted by the steam. The indicated power consists of the net power delivered and, in addition, that consumed in propelling the engine itself.

In this connection, the indicator proves invaluable for measuring the amount of power transmitted to a machine, or set of machines, which the engine is employed to drive. The process of measuring power thus used consists in indicating the engine, first with the machinery in operation, and then with the driving belt or shaft thrown off. The difference in the amount of power developed in the two cases is the desired result. Tenants and those who let power frequently employ the indicator for this purpose. The method of computing the power from the diagram is given later.

Steam Consumption Computation

3.—The indicator has a third use in connection with a feed-water test, in determining the number of pounds of steam consumed by an engine per indicated horse power per hour. This quantity forms a measure of the performance of an engine, and, when compared with the performance of the best of its class, shows the economy with which the engine works. The amount of steam consumed is usually found by weighing the feed-water before it is supplied to the boiler, the steam being employed during the test for no other purpose than driving the engine. This requires the erection of a weighing apparatus, the most satisfactory form of which consists of two tanks and platform scales. One tank is placed on the scales and these are elevated above the second tank, which is of comparatively large size. The water is primarily drawn into and weighed in the first tank. It is then emptied into the second tank, which serves as a reservoir, and from this it is pumped into the boiler.

A simpler plan may be resorted to, which gives approximate results. The feed-water is brought to a high point on the glass water gauge and then shut off, and a test made by observing the rate at which the water boils away. A fall of six inches may be allowed in nearly every case, without again feeding. The heights at the beginning and the end of the test being carefully observed, the amount of water evaporated and supplied to the engine is computed from the cubical contents that it occupied in the boilers. A test made in this manner can be repeated a number of times, and the results averaged to insure great accuracy. Feed-water tests, made by measuring the water fed to the boiler are of no value unless leakage of water from the boiler, if any exist, is allowed for. Attention should always be given to this point and the rate of leakage determined by observing the fall of water in the gauge. when no steam is being drawn from the boiler, a constant pressure being maintained.

Leakage, Etc., Losses

A portion of the feed-water consumption of an engine may be found without the aid of a feed-water test, by computation from the diagram. Were it not for the losses produced by leakage and cylinder condensation, to which engines are subject, the whole amount of feed-water consumed might be determined in this manner. Leakage of steam often occurs and cylinder condensation is inevitable, while the extent to which these losses act is not revealed by any marked effect produced upon the lines of the diagram. The measurement of the consumption of steam by diagram, therefore, cannot be taken to show actual performance, without allowing a margin for these losses. Much value, however, often attaches to these computations.

Besides showing the economy of an engine compared with the best of its class, the indicator, by means of the feed-water test, reveals the extent of the losses produced by leakage and cylinder condensation. These losses are represented by that part of the feed-water consumption which remains after deducting the steam computed from the diagram, or steam accounted for by the indicator, as it is termed. One of these losses, condensation, is nearly constant for different engines working under similar conditions, and an allowance may be made for this amount. The other, leakage, is variable in different cases, depending upon the condition of the wearing surfaces of the valves, piston and cylinder. The fact of the presence of the latter may be detected by a trial under boiler pressure with engine at rest, the leakage being revealed by escape at the indicator cock or exhaust pipe. The extent of its action may be found by computing that part of the loss not covered by condensation. In other words, in the case of leaking engines, when the indicator and feed-water test show that there is more loss than is produced in good practice by condensation, the excess represents the probable amount of loss by leakage. The indicator thus finds a valuable use in connection with the feed-water test.

OIL ON GOVERNOR BELTS

I HAVE known many governor belts to be ruined in a short time by oil getting on them, says a correspondent of the Dodge Idea. Oilers generally, and engineers quite often, are negligent in this regard. The governor belts on some Corliss engines run under idler pulleys. It is a safety arrangement. Should the belt break, the idler pulley will drop, and will thus throw the safety cams in such a position that the steam valves will not open. Often the idler pulley is oiled too freely and some of the oil gets onto the belt.

I have found it a good plan to lubricate the idler pulley with grease. You can screw in a nice tidy compression cup, load it with grease and go about your other affairs, confident that your idler pulley will keep spinning around a well-greased stud the livelong day, and that none of the grease will squash out and get on your belt. I have found it good practice to let a new governor belt run with the joint laced until the belt has stretched pretty well, and then to splice the ends so as to make the belt endless.

FIREPROOF PAINT FOR BOILER ROOMS

FOLLOWING is the recipe for a good durable, fire-proof paint, for use in boiler rooms, engine rooms, and on the stairways, which the fire insurance inspectors often order painted with fireproof solution. It must not be understood that wood treated will not be affected by fire. On the contrary, fire will affect it as it does any wood, but the solution will keep the wood from breaking into flame for a considerably longer time than if not treated, and will prove a big factor in keeping the fire from spreading. Dissolve into a sufficient quantity of water to make the solution the thickness of thin paint, 150 parts ammonium sulphate, 100 parts crystal borax, and 50 parts sal ammoniac. To this add any coloring desired (dry powdered colors are the best), and a sufficient amount of glue size to bind the paint, after which it is ready for use.

Question and Answer Section

Boiler Working Pressure.—What is the safe working pressure of a return tubular steam boiler 60 inches in diameter by 16 ft. long, with shell plating $\frac{3}{8}$-inch thick, and having the longitudinal seams double riveted with double butt straps? What would be the safe working pressure if the longitudinal seams consisted of single riveted lap joints? A factor of safety of 6 is assumed in each case.—J. W.

* * *

Multiply together the ultimate tensile strength of the shell plate material, twice the thickness of the latter in inches or fraction of an inch, and the least percentage strength of the riveted longitudinal seams, and divide the product by the diameter of the boiler shell in inches multiplied by the factor of safety,. Thus, if the ultimate tensile strength of the shell plate be taken as 60,000 pounds per square inch, and the percentage strength of the riveted longitudinal seams be taken at 75 and 55 respectively, we get W.P. = $\frac{60{,}000\times2\times.375\times75}{60\times6\times100}$ = 93.75 pounds for the double riveted double butt strap joint, and W.P. = $\frac{60{,}000\times2\times.375\times55}{60\times6\times100}$ = 68.75 pounds for the single riveted lap joint. In the formula given, W.P. represents working pressure in pounds per sq. inch; 2 represents twice the plate thickness; .375 represents one thickness of plate in decimals of an inch; 60 represents inside or mean diameter of boiler shell in inches; 6 represents the assumed factor of safety; while $\frac{75}{100}$ and $\frac{55}{100}$ represent 75 and 55 per cent. respectively for the two types of riveted joint.

A single riveted lap joint on the longitudinal seams of a steam boiler is a relic of barbarism, as is practically any type of lap joint so applied. The factor of safety may be as low as 4.5 in up-to-date designed and constructed boilers; the ultimate tensile strength of the material may be had to vary anything between 55,000 and 65,000 pounds per sq. inch, and the strength of the longitudinal seam be in amount as high as 93 per cent.

* * *

Boiler Horse Power.—How may I calculate the horse-power of a tractor boiler, a flue boiler and a water-tube boiler? —S. L. G.

Boiler horse-power, it may be stated at the outset, is a misnomer, and should be reckoned as simply a convenient and compact means of making comparison of boiler capacities for commercial purposes. A boiler, no matter its classification, form or type, be it horizontal or vertical, smoke-tube or water-tube, internally or externally fired, designed and constructed for high, medium or low pressure, and be it installed ashore or aboard ship, is essentially a vessel in which steam is generated. The power is in the steam and little exemplification of that power is to be had as far as the boiler is concerned except when the latter blows up, and we have what is known as a boiler explosion of lesser or greater magnitude.

On this continent the accepted commercial rating of one boiler horse-power is taken to represent an evaporation of 30 pounds of water per hour from a feed water temperature of 100 degrees Fah. into steam at 70 pounds gauge pressure, this being considered as equal to the evaporation of 34½ pounds of water from a temperature of feed water of 212 degrees Fah. (boiling point of water) into steam at the same temperature. Further, a boiler rated at a given horsepower is expected to demonstrate same with easy firing, moderate draught, with ordinary fuel, and to show at least a fair measure of economy. Again, the boiler should be capable of developing from one-fourth to one-third in excess of its rated power if called upon in an emergency.

Tractor, flue, water-tube, or for that matter any classification of boiler come under this commercial horse-power rating if their manufacturer so will it, at the same time there is nothing compulsory about acceptance being all inclusive, in which circumstance, a boilermaker may adopt a rating to suit himself and that of his clients. The boiler generates steam, the engine develops the power, and the principal concern is in our seeing to it that the boiler capacity for steam generation is ample for the duty that the engine has to perform, and that the greatest economy of fuel is being realized. Rough-and-ready rules for computing boiler ratings may be taken as 12 sq. ft. of heating surface, or one-third sq. ft. of grate area per boiler horse-power respectively.

* * *

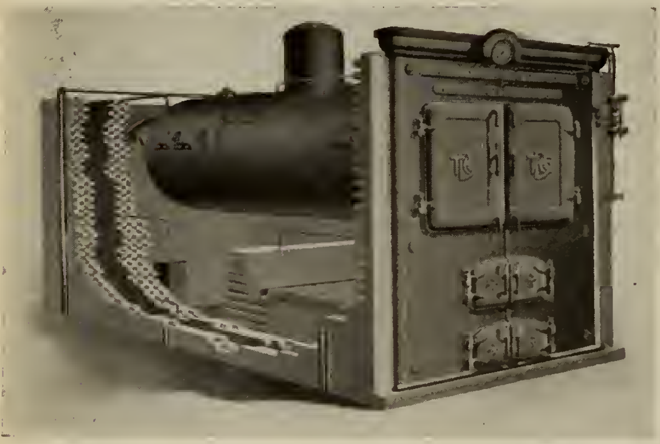
Dampers and Ashpit Doors.—I would be glad to have an opinion regarding the use of dampers and ashpit doors. Where a battery of boilers is installed, is it better to open ashpit doors wide and operate the dampers, or open the dampers wide and operate the ashpit doors?—W. H. M.

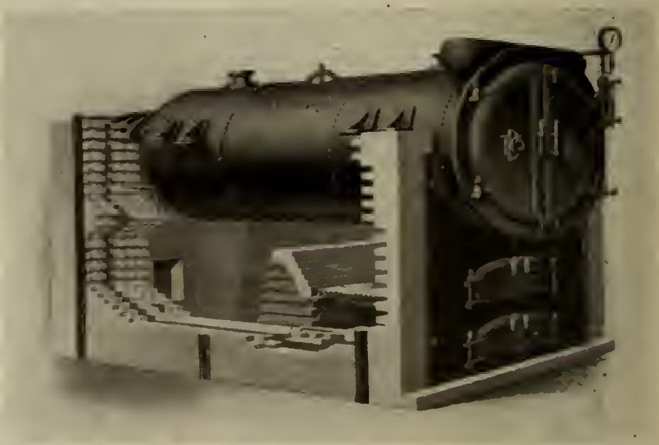
The air supply for the proper combustion of the fuel on the fire grate is receivable from the mouth of the ashpit, and, to at least assist in the regulation of that air supply, ashpit doors are fitted. Stack or breeching dampers are installed for the purpose of controlling the draft, and, in so doing, they incidentally play a part in regulating the air supply from the ashpit opening through the fuel bed. With the stack or breeching dampers wide open and regulation dependent wholly on the ashpit doors, the full draft of the stack is "pulling" on the furnaces, and if the ashpit doors be nearly closed, the effect produced is that an increased amount of air is drawn into the furnaces from numerous other points, such as from defective and cracked brickwork settings; from around cleaning and inspection doors; from along the line where brickwork closes around the shell in the case of a tubular boiler; and from poorly built or damaged dividing walls between a battery of boilers, where one or more of them may be out of service; etc. The amount of air drawn in over the fire will also be increased. If less draft be desired, part closure of the stack or breeching dampers will reduce the "pull" of the stack, and naturally will lessen the quantity of air drawn in from the undesirable sources just indicated.

To regulate or change the stack draft then to meet varying conditions and requirements of operation, it will generally be found most advantageous to do so by means of the stack or breeching damper, in which case the ashpit doors would be nominally full open. It will always be possible, however, to supplement the damper control by some attention to ashpit door regulation, and there is no good reason why the most should not be made of the latter feature. The closing of the ashpit doors when there is a sudden stoppage of the demand for steam—temporary or otherwise, is exemplification of a convenient form of ashpit door regulation, and many of a more or less similar nature will readily occur to the reader.

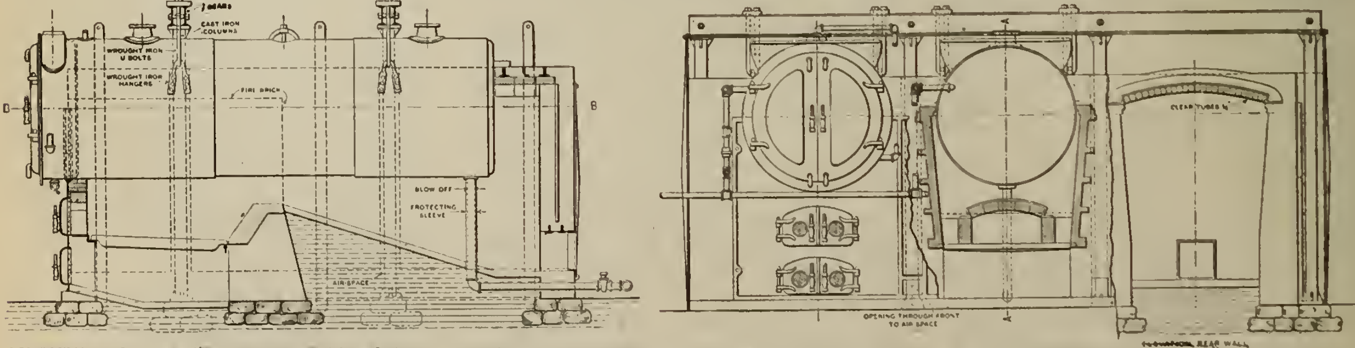
* * *

Boiler Installation.—How would you instal a horizontal return tubular boiler of 60 inches in diameter by 16 ft. long? Give illustrations of same showing the number of lugs on each side, and indicating at same time how the boiler is hung.—W. J. M.


RETURN TUBULAR BOILER WITH FULL FLUSH FRONT SET IN BRICKWORK, THE BOILER WEIGHT BEING CARRIED ON SIDE WALLS.


RETURN TUBULAR BOILER WITH HALF OR OVERHUNG FRONT SET IN BRICKWORK, THE BOILER WEIGHT BEING CARRIED ON SIDE WALLS.

The accompanying half-tone and line cut illustrations in their sectional and otherwise detail features indicate so clearly of themselves the particular points on which information is required that it seems somewhat superfluous to make further explanation. The halftones illustrate return tubular boilers with half or overhanging front, and with full flush front respectively, set in brickwork, the double lugs on each side resting on the brick side-walls and thereby supporting the boiler weight.



LONGITUDINAL AND CROSS SECTIONAL VIEWS OF RETURN TUBULAR BOILER SET IN BRICKWORK, THE BOILER WEIGHT BEING CARRIED FROM OVERHEAD.

In the line drawings are shown longitudinal and cross sectional views of the same type boiler, the latter being hung. however, from overhead girders. Steel plate eyelets, it will be noted, give place to the lugs or brackets in the former instance. Both methods of installation are quite common, although probably the first named predominates.

* * *

Hydro-Electric vs. Steam.—The firm with whom I am employed propose to use hydro-electric power for plant operation, and I am trying to show them that little is to be gained by so doing. We use both exhaust and live steam for heating. About 35 horse-power is all that my engine is called upon to deliver, and it has occurred to me that if it were further loaded—which it can comfortably stand—more exhaust steam would be available for heating, so much so that possibly the present use of part live steam for that purpose might be wholly eliminated. We use about two tons of coal every ten hour-day, and I would like to know how much of that belongs to the power output of the engine. I have taken an indicator card from the latter, but don't know how to calculate the steam and coal consumpt from the card. Can you help me out?—G. E.

Unless some better reason can be adduced than the procuring of more exhaust steam to eliminate such live steam as is now supplementing the heating requirement, you will probably find it hard to convince your employers that installing hydro-electric power for their plant operation is an unwise, because unprofitable move. No doubt their manufacturing equipment is equal to the market for its product and probably something in excess, in which event giving your engine more work to do is outside the range of possibility. If you will kindly send forward some of the indicator cards taken from the engine, we will analyze them and advise you as to your chances of "putting one over" hydro-electric power. On each card please mark boiler pressure, scale of indicator spring, cover and crank ends, whether full load, three-quarter load, half-load, or quarter-load, and revolutions per minute. Cylinder diameter and stroke, whether simple slide valve, Corliss valve, or slide and expansion valves should also constitute information to be furnished.

* * *

Boiler Plate and Rivet Strengths—I have an engineers' book in which the author states that the tensile strength of steel boiler plate is 60,000 pounds per sq. inch, and that of steel rivets as being equal to 45,000 pounds per sq. inch, whether the joints in which the latter are used be of lap or butt strap type. He does not show where he gets his figures. I want to know not only about the tensile strengths, but also about the crushing and shearing strengths relative to steel boiler plates and rivets, so that I may calculate in a proper manner, and acceptable to an Engineers' Examining Board, riveted joints, of the modern steam boiler as built in Canada.—W.C.

What is asked is more or less complicated, and we hope does not constitute the examination requirement. The tensile strength of steel boiler plate given as 60,000 pounds per sq. inch is simply a reasonable and in many cases an insisted-on requirement of the material. The steel mill meets the requirement when rolling the plates, and to show that it has done so, test strips taken from the plates as manufactured are proved in a testing machine for such specific purposes. The steel mill management will produce plates or rivet bars to show a tensile strength above or below 60,000 pounds per sq. inch if these be required, and, practically speaking, as much above or below as one desires. The amount 60,000 is purely arbitrary, and is not in any sense universal, being called for below or above, according to convenience or enactment. The amount of 45,000 applicable to rivets, assumes the shearing strength of the latter to be 75 per cent. of their tensile strength, being again a purely arbitrary amount, and in no sense universal of adoption. Boiler shell plates are in tension; the rivets, no matter what the style of joint, are in shear. Crushing in the case of a boiler shell-plates or rivets, is absent. Plate thickness, quality and tensile strength being agreed upon, the type of joint employed on a given diameter of boiler shell whose factor of safety corresponds will determine the working pressure.

As already noted, an ultimate tensile strength of 60,000 pounds per sq. inch for boiler shell plate is purely arbitrary. There is, however, more or less reason for its adoption, just as there is for the adoption of a higher or lower figure, which a steel mill must meet when filling the order for such material. The lower the tensile strength comparatively, the more ductile and easily worked it is; correspondingly, the higher comparatively, the harder or more brittle is the materials. Where lap joints are employed, the joint faces on each end of the plate require offsetting to some extent so as to come together in such a manner as to preserve the uniformly rolled circular shape as nearly as possible. Work, more or less hurtful to the material, has to be done to attain this, and may be accomplished by hammering cold, or otherwise. In such circumstance a tensile strength of 50,000 to 55,000 is largely employed, the plate at the offset laps suffering less than it would with a materially higher tensile strength. Where butt strap joints are employed, no offsetting is required, hence higher tensile strengths are in vogue, these ranging up to 70,000 pounds per sq. inch, and probably higher, where extreme lightness of the finished boiler, combined with greatest possible relative strength for a given duty, are the primary consideration. A tensile strength of 60,000 pounds per sq. inch, and a shearing strength of 45,000 pounds per sq. inch for steel boiler plates and rivets respectively, occupy a somewhat happy mean between what is ductile but less strong, and what is comparatively hard and brittle in tendency, but indicative of greater strength. It should be borne in mind that the lower the tensile strength adopted, a heavier plate for a given pressure, or a lower pressure for a given plate thickness are realized comparatively.

* * *

Spring Safety Valves—A steam boiler is equipped with two safety valves, each of 3½ inches in diameter. The spring wire is ⅝ inch in diameter. What should be the allowable working pressure, the outside diameter of the spring and its length, also what should be the grate area of the boiler in sq. ft.—N.L.

Reckon the grate area as one square foot per ½ sq. inch area of one safety valve. The area of a 3½ inch diameter valve equals $3.5\times3.5\times.7854=9.621$ sq. inches, and this divided by .5 sq. inch, or

$$\frac{9.621}{.5}=19.24 \text{ sq. ft. grate area.}$$

British Board of Trade rule for working pressure of safety valves consists in multiplying 37.5 (a constant) by grate area in sq. ft. and dividing by the area of one valve, thus,

$$\frac{37.5\times19.24}{9.621}=75 \text{ lbs. per sq. inch working pressure.}$$

Regarding the outside diameter of the spring, it is considered good practice to make distance from centre to centre of wire equal to five diameters of the latter, then add one wire diameter which will give the coil diameter outside. Thus $(5\times.625)+.625=3.75$ inches outside diameter of spring.

The initial compression on a safety valve spring should be not less than one-half the valve diameter which in this instance would therefore be 1¾ inches, and allowing say a further ¾ inch to amply cover further compression due to valve lift, a total of twelve free coils should be provided, each taking as it were one sixteenth of the ¾ inch allowed. Adding the two end coils we get a total length of spring of fourteen coils. Round steel is assumed for the spring wire.

* * *

Centrifugal Pumps. — I am puzzled over the size of a centrifugal pump, and shall be glad to have some information concerning same. Given the diameter of the impeller, revolutions per minute, and feet head to be pumped against, how much water will pump throw per minute? Again, given the quantity of water delivered per minute, also the head in feet, what size pump would be required? Also what horse-power would be required for operation? I have looked through various books in my possession for formulae relative to the above, but have been unable to locate anything.—J. M. V.

The amount of water which a given pump runner or impeller will discharge depends directly on the dimensions of the impeller openings which are related to its diameter and the speed at which it rotates. The pressure against which this quantity of water can be discharged depends upon the diameter of the impeller and the square of the speed at which it is rotated. The power required to rotate the impeller depends upon the cube or third power of the rotative speed. The efficiency with which a centrifugal pump operates depends upon the proper proportioning of the various dimensions so that there shall be no abrupt changes in the velocity or direction of flow as the water passes through the pump, and as little surface frictional loss as possible. This latter consideration means that the wet surfaces in the runner and casing should be small in proportion to the amount of water passed and that the velocity of the water over these surfaces should be as low as possible. Also that these surfaces be smooth.

Centrifugal pump sizes in a commercial sense are determined from their inlet and discharge openings, and the diameter of these approximate $.64\sqrt{Q}$, where Q equals the maximum number of cubic feet of water per minute to be delivered. The diameter of impeller may be taken as approximately equal to $1.8\sqrt{Q}$, and its width at the periphery or vane tips as the pipe diameter divided by 4. The speed of periphery of the impeller may be taken as anything between $8\sqrt{h}$ and $11\sqrt{h}$, according to circumstances. Centrifugal pump design for any given duty does not lend itself to either a theoretical or empirical formula rendering, besides an apparently trifling and practically unobservable variation in some interior detail during construction may easily upset the most elaborately developed formula, either theoretical or empirical. Trickiness of performance relative to efficiency is the problem that centrifugal pump makers are always more or less up against, therefore those not so involved, although interested, cannot expect to get in any way close to the vitals of a subject so full of variables.

◆

The lightest wood known is called balsa, other names being corkwood, floating wood, or lanero. The heaviest wood is black ironwood. A cubic inch of ironwood will balance on the scales ten cubic inches of balsa. Ironwood is used for rudder posts on ships; balsa is used on the same ships in life-preservers and life-rafts.

Steam Power Plant Auxiliaries

STEAM TRAPS—II.

THE constantly increasing use of low pressure and vacuum steam heating systems has resulted in the development of many types of devices for controlling the discharge of air and water of condensation from the radiators or other heating surfaces without permitting the loss of steam. For traps employed on this work the thermostatic principle is very suitable on account of the compactness of design obtainable through its employment.

Webster Water-Seal Valve

A successful adaptation of the float type of trap is found in the Webster Water-Seal Motor, which is one of many similar appliances used in connection with the Webster Vacuum and Modulation Systems. It is connected to the return line of each unit of radiation and at such drip-points as are necessary. A sectional view of the interior of this valve is shown in Fig. 5, from which it will be seen that a cylindrical float having a tube through its centre is guided by a depending stem or guide-rod, which has a screw threaded surface.

The lower end of the tube performs the functions of a valve disc, and rests upon a specially constructed seat made to be removed from the body for the purpose of allowing the entire heating system to be blown out thoroughly when installed, the seat being replaced after this is done. The tube and seat are accurately made and fit closely, eliminating any possible leak of steam at this point.

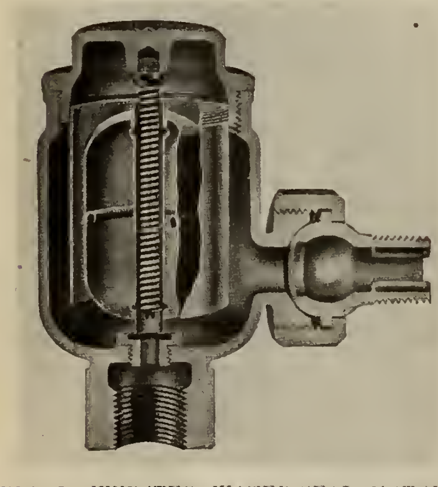


FIG. 5. WEBSTER WATER-SEAL MOTOR FOR DRAINING HEATING SYSTEMS.

The above-mentioned depending stem is primarily intended to act as a guide on which the float will operate freely, yet it is sufficiently close-fitting to prevent the direct escape of steam or vapor although permitting these bodies to pass in a downward direction through the spiral passage formed between the screw-threaded stem and the inside of the tube. In action, the float is given a slight rotative motion, which relieves the device of the fine sand or oxide of iron which is inherent in any heating system. The top of the screw thread forms a reduced bearing which does not catch and hold dirt, while the friction is at a minimum.

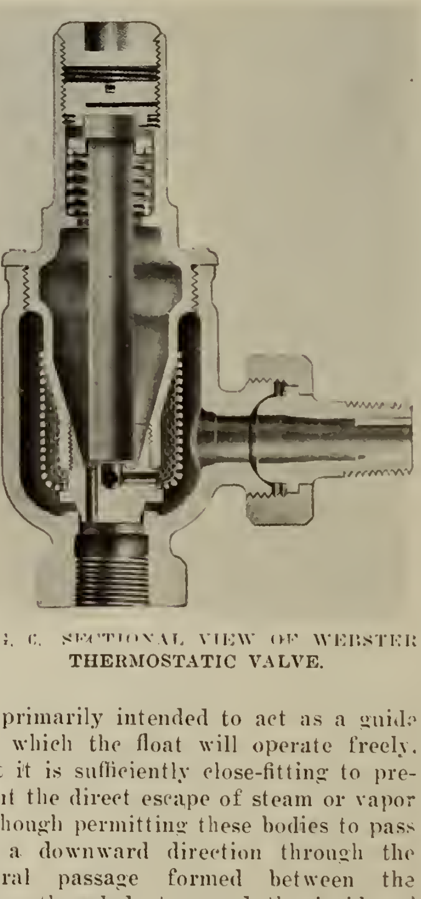


FIG. 6. SECTIONAL VIEW OF WEBSTER THERMOSTATIC VALVE.

No manipulation is required in the operation of this water-seal valve which is entirely self-adjusting. On the entrance of steam into a cold radiator, the air is displaced and expelled, passing from the radiator into the inlet passage, upward through the annular passage between the float and the surrounding sleeve, to the top of the bonnet or cap, from which point it passes downward through the thread spaces between the guide-rod and the inside of the tube, to the discharge opening, and thence into the returns. This exhaustion is completed almost instantly.

Meanwhile, the steam which has entered the radiator expands rapidly, and condenses in giving off its heat by radiation. The water so formed flows into the valve body and rises until it is elevated to such a point as to form a water-seal between the sleeve and the float, and commences to buoy the latter.

The lifting of the float raises the tubular valve piece off its seat, and the solid body of water is discharged through the opening of the seat into the return line. The float remains raised until the buoying water has escaped, when it drops to its original position, thus seating the tube on the valve seat.

This action continues intermittently according to the varying quantities of condensation, the air and water being thoroughly ejected, although the steam vapors are not allowed to escape.

In Figs. 6 and 7 are shown two Webster devices for heating systems, operated thermostatically. The principal feature of the former is the expansion valve member which is adjustable from the top by removing a plug. The valve seat is carried in the lower end of the cap, which is in the form of a chamber, the valve seat being so constructed that the water and steam vapors enter the chambers upwards through the central hole and surround the expanding member, which expands as the temperature

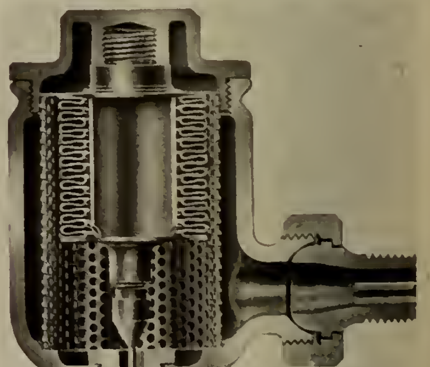


FIG. 7. SECTIONAL VIEW OF WEBSTER SYLPHON THERMOTOR.

rises until it closes against the seat. The vertical hole right through the seat maintains the chamber in direct communication with the returns, so that the temperature of the expansion member does not rise any higher than is necessary to close the valve.

A corrugated cylinder containing an expansible liquid is the operating element of the trap shown in Fig. 7. The corrugations are of such a shape and sufficient number that considerable changes in length may take place without stressing any portions of the cylinder unduly. The cylinder is hermetically sealed after being filled with the liquid which can only expand lengthwise, so that slight changes in its temperature cause relatively large movement of the valve on the lower end of the cylinder. Means of adjustment are provided so that the valve will pass water and air freely, but will seat tightly when the hot steam vapors come in contact with the cylinder.

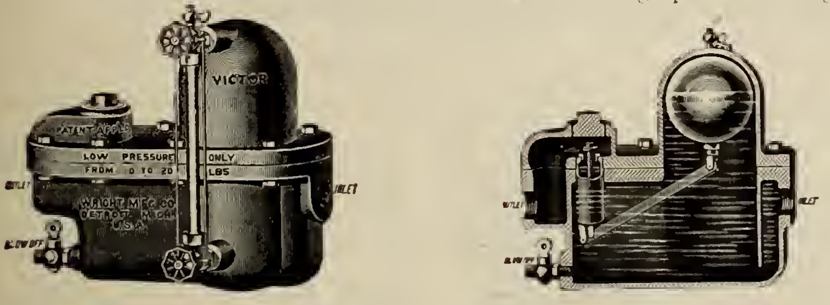


FIG. 8. WRIGHT VICTOR TRAP FOR PRESSURES UP TO 20 LBS. PER SQ. IN.

Wright Steam Traps

In addition to manufacturing the various devices used in connection with Webster heating systems, Darling Bros., Montreal, also make the Wright steam traps in two types, suitable for low and high pressures.

Two views of the low pressure type are shown in Fig. 8. This trap is of the float type, and is suitable for steam pressures up to 20 lbs. per sq. in., although it is also capable of operating when there is no pressure whatever, as the parts are so proportioned that the incoming condensation alone is sufficient to lift the valve. The body of the trap is so proportioned as to provide a deep water seal, covering both inlet and outlet, which prevents the direct passage of steam through the trap. This seal is maintained steadily, as discharge does not take place until the water reaches the level of the valve.

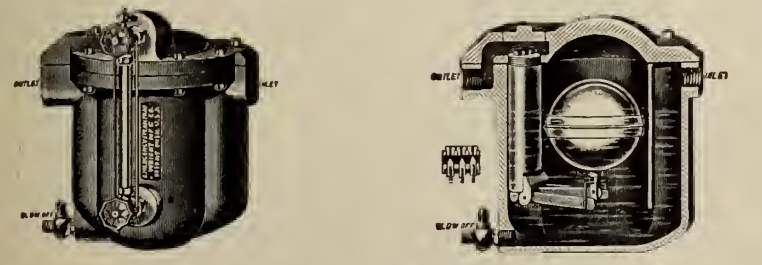


FIG. 9. WRIGHT HIGH PRESSURE EMERGENCY TRAP WITH TRIPLE DISCHARGE VALVE.

High Pressure Type

The other type of Wright steam trap is known as the high pressure emergency and will operate on pressures up to 200 lbs. per sq. in. (see Fig. 9). Three steam-tight outlet valves are employed in place of one, and are located at the highest point of the trap, where they are entirely removed from grit, scale and sediment. Blow-off taps for removing deposit are provided in both types of these traps.

Davis Float Trap

An interesting type of trap for general service is the Davis, made by the G. M. Davis Regulator Co., Chicago, possessing several features of interest to trap users. This apparatus is of the float type with balanced valves continually submerged during working. The phantom view in Fig. 10 shows the arrangement of interior mechanism, which is entirely attached to the cover and removable with it. Entrance of condensation through the inlet above the float first floods the valves and creates a permanent water seal for the outlet. As the water level rises the float is lifted, opening the valves and permitting the escape of water to the outlet. The valves remain open to continuous flow so long as the condensation continues to enter and the float is held up; when the flow stops and the level falls, the float descends, closing the valves which are water sealed to a depth of from two to four inches.

The form of the valves is such that for slight flow of condensation they provide a correspondingly small opening; while for higher rates of flow they automatically provide a passage of increasing area as the float rises to its extreme height, thus providing a self-regulating discharge of continuous flow for any rate of influx up to the limit of capacity.

Balanced Valves

The use of two valves, each of ample proportion, provides full capacity for the size of pipe connections provided. One of these valves opens upward and the other downward, giving perfect balance with and against the inlet pressure, the result being that the trap is not only sensitive in action, but is also suitable for either high or low pressure work, from 1 to 200 lbs. pressure. Both valves and seats are of Tobin bronze, the valve casing is of high-grade steam metal, and the trap body is of cylindrical form, well adapted to withstand high pressure.

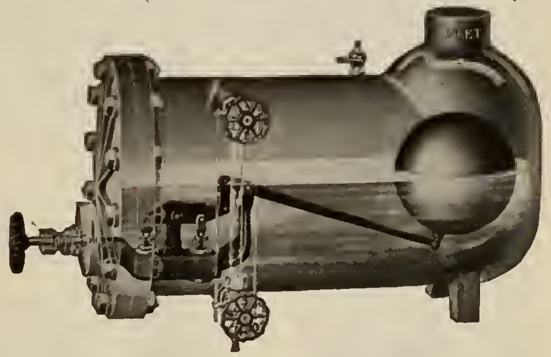


FIG. 10. PHANTOM VIEW OF DAVIS TRAP SHOWING BALANCED VALVES AND MECHANISM ATTACHED TO COVER.

When the cover is removed, all of the working parts come with it, and are thus removed intact for inspection, adjustment, or repair, without disturbing the pipe connections in any way. A self-contained by-pass is provided in the cover, by opening which the interior of the trap body may be drained before removing the cover. The discharge outlet is situated on the opposite side of the trap body from the gauge glass. The trap is made in eight sizes, from ½-inch to 3 inch connections with capacities from 1,500 to 60,000 lineal feet of 1-in. pipe.

Armstrong Submerged Bucket Trap

Among the peculiar features possessed by this trap are an inverted submerged bucket which will act independently of any change of pressure, and an arrangement of parts which effectually removes any possibility of the device becoming air bound. Fig. 11 is a sectional view, which shows clearly the action of the various parts.

The inlet or supply pipe is connected to the centre of the bottom where the air, water, steam, etc., enters directly beneath an inverted bucket. This bucket hangs on a pivot from a system of compound levers which operate the valve located at the highest point of the trap. When not in operation, the weight of the inverted bucket causes it to rest on the bottom of the trap, holding the valve wide open. Small feet on the bottom edge of the bucket maintain an open space between it and the bottom of the trap. Water entering through the inlet fills the body of the trap and the bucket, the air escaping through a small vent in the top of the bucket, as shown in Fig. 11. The trap, therefore, becomes filled with water up to the top, and as the bucket is still submerged at the bottom of the trap, the discharge valve remains open allowing the flow of water to continue indefinitely.

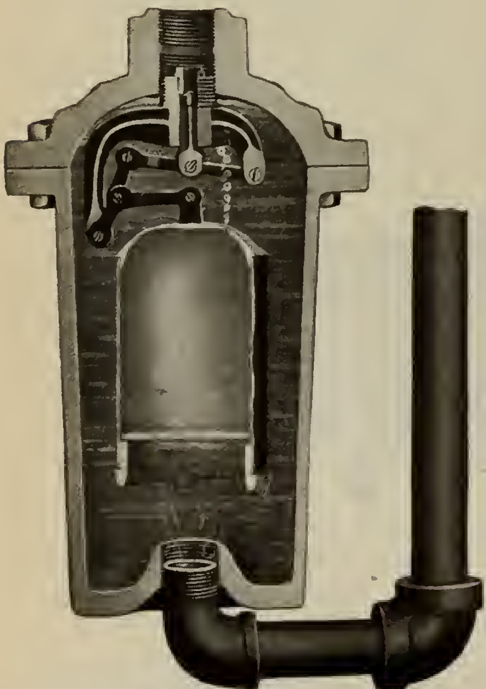


FIG. 11. ARMSTRONG TRAP WITH SUBMERGED BUCKET SHOWING METHOD OF PREVENTING AIR-BINDING.

When steam commences to enter the trap, however, it rises through the water to the top of the bucket, displacing some of the water until the accumulated steam imparts sufficient buoyancy to the bucket to make it rise quickly through the full range of its motion thus closing the outlet valve.

The vent, through which the air and other incondensable gases escape, also permits a similar escape of steam, but owing to the restricted size of the vent, the amount of steam which escapes is easily condensed by radiation from the trap body. As long as a full head of steam is maintained in the inlet pipe, the bucket would be buoyed up until the gradual accumulation of water from the condensed steam through the vent, reduced the space which the steam occupied, thus reducing the buoyancy of the bucket which now descends and allows the main body of water to flow through the discharge outlet until such time as a fresh inflow of steam causes the float to rise and close the valve.

By this arrangement the air is collected on the top of the trap and remains there ready to escape with the first opening of the valve. Such air and other incondensable gases, together with all liquids, pass through freely, but steam will not. The arrangement of levers is such that the greatest force is applied at the instant of unseating the valve, insuring certainty of action with the use of large valve area.

Trade Gossip

The Canadian Fairbanks-Morse Co., Toronto, have been awarded a contract for the pumps for the Ridgetown, Ont., waterworks.

Chatham, Ont.—A by-law authorizing an expenditure of $16,600 for new water mains to the sugar factory and the cemetery has been passed by the council.

E. P. Coleman, general manager of the Dominion Power & Transmission Co., of Hamilton, Ont., has been elected president of the Canadian Electric Railway Association.

St. John, N.B.—The City Council has decided to proceed with the construction of a power house and laundry of the General Public Hospital at an estimated cost of $46,000.

New Glasgow, N.S. — The Town Council propose extending the waterworks system at a cost of $100,000. E. S. Fraser of New Glasgow is preparing plans.

Aurora, Ont.—The Town Council have engaged James, Loudon & Hertzberg, consulting engineers of Toronto, to prepare plans for a sewerage disposal system.

Aylmer, Que.—The lowest tender recently received for the proposed water filteration plant was submitted by the Norwood Engineering Co., of Cowansville, Que., at $33,000.

The Canadian Fairbanks-Morse Co., Toronto, have been awarded a contract for a 30 h.p. motor-driven vertical centrifugal pump by the Town Council of Palmerston, Ont.

Halifax N.S.—The Board of Control have received tenders on water meters but no award has been made yet. It is likely that 500 meters will be purchased at the present time and not 3000 as was originally intended.

Toronto, Ont.—The plans for the William Davies Co. new abattoir, have been prepared by Henschien & McLaren, of Chicago. The buildings will cost about $200,000.

Peterborough, Ont.—The city council propose installing an activated sludge sewage disposal system which will cost $125,000. The Provincial Board of Health are dealing with the matter.

Lawford Grant, sales manager of the Eugene F. Phillips Electrical Works, Montreal, has been appointed assistant general manager and assistant treasurer, with a seat on the board of directors.

Fred Armstrong, a Toronto electrical contractor, has been elected a member of the board of the Port Hope Sanitary Manufacturing Co., and will in future act in the capacity of managing director.

Kingston, Ont.—It is reported that there is a proposition on foot to have the C.P.R. line from Kingston to Renfrew electrified, and that power will be secured from the Mississippi River to operate the road, and also meet the needs of Kingston and adjacent towns.

Swift Current, Sask.—The City Council proposes to make extensive additions to its power plant. Two plans of operation are contemplated, one a gas plant at a cost of $100,000 and the other a steam plant to cost $34,000. J. W. Calder is city engineer.

Montreal, Que.—The British Munitions Co. had their plant equipped with three refrigerating machines of 50 tons capacity each, together with three batteries of cooling coils, all furnished by the Frick Co., Waynesboro, Pa., and installed by the Carrier Engineering Corporation, New York, N.Y.

Fredericton, N.B.—A new pumping station is to be erected at the Experimental Farm to take the place of the station destroyed by fire in March, 1915. The new building is to be two stories high and will cost about $3,000. William Richards has been awarded the contract for the concrete work. J. A. Grisdale, of Ottawa, is Director of Experimental Farms.

Kitchener, Ont.—At a meeting of the City Council held on Sept. 5, the recommendation of the Finance Committee that the request of the Water Commissioners, asking the Council to raise the sum of $100,000 for the erection and completion of a waterworks plant in Bridgeport, with the necessary connections to the present system, be granted, was adopted. The plans for the new system have been accepted by the Provincial Board of Health.

Progress in New Equipment

IMPROVED CENTRIFUGAL BOILER FEED PUMP

THE development of the steam turbine and the high efficiency multi-stage centrifugal pump have gone hand in hand, but up to the present, it has not been entirely practicable to reconcile the speeds of the two machines so that each would work at its best efficiency. It has been necessary, heretofore, either to reduce the speed of the turbine and sacrifice much of its efficiency, or else speed up the pump with similar results. To overcome this difficulty, the Cameron Pump Works, 11 Broadway, New York, have designed and built a multi-stage centrifugal pump, known as the "BT" type.

Fig. 1 shows the construction of one of these three-stage pumps. The high speed feature—the pump can operate with a steam turbine driven speed of 3,100 r.p.m.—is a virtue of impeller design. With the ordinary impeller the diameter cannot be reduced sufficiently to get high speed without sacrificing vane length, and consequently, efficiency, for a certain vane length is very necessary in order that the impeller perform its function without excessive loss. Small external diameter and adequate vane length are obtained in this pump by bringing the vanes well down into the impeller hub, at the same time so turning them that the incoming water is guided smoothly and with little loss into the outer portion of the vane where the velocity is generated that is finally converted into useful pressure by means of the external diffusion vane. Additional advantages in the small impeller are light weight and low fibre stresses in the material.

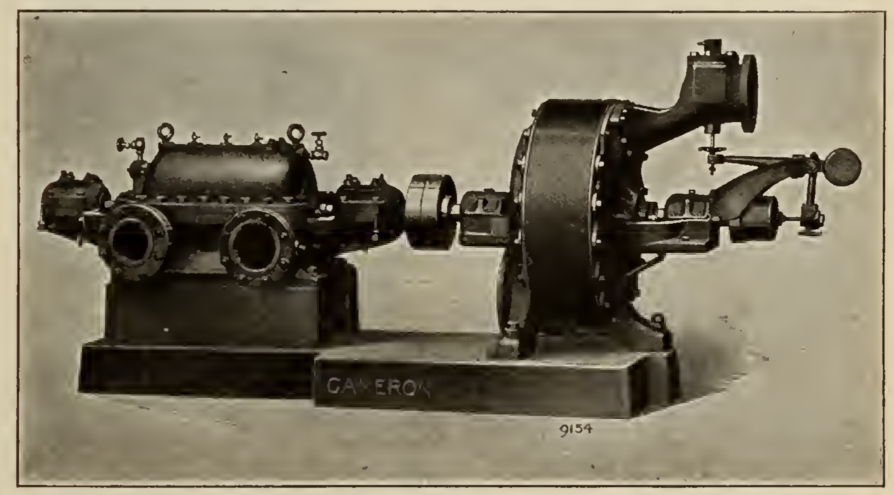


FIG. 2. SHOWING PUMP COUPLED TO STEAM TURBINE.

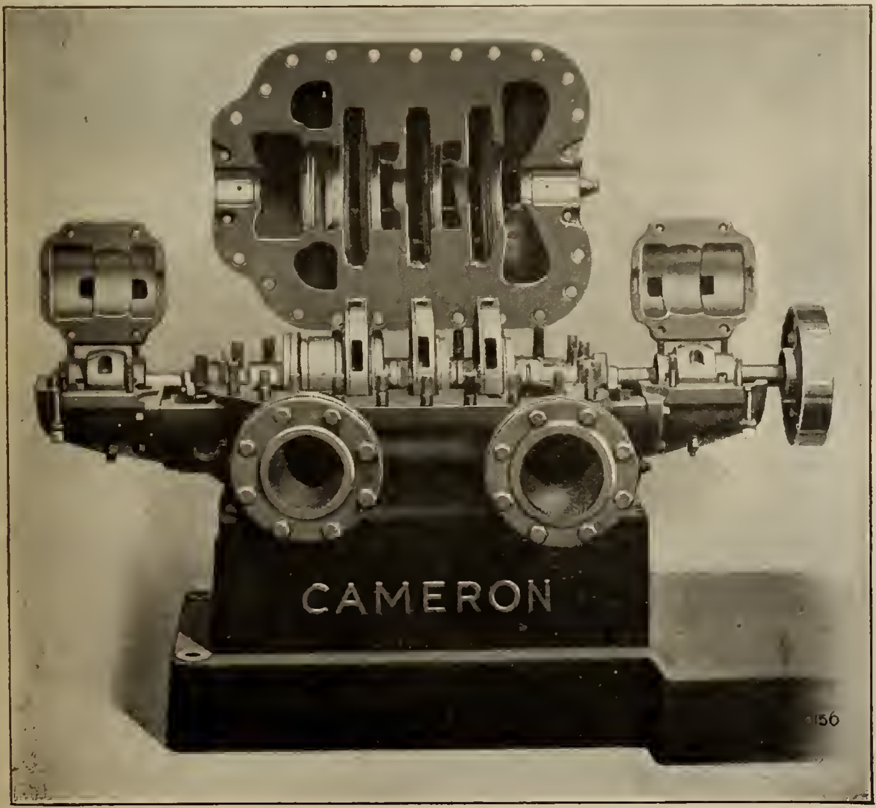


FIG. 1. SHOWING CONSTRUCTIONAL FEATURES OF PUMP.

The casing is divided along the horizontal outer line, and both the suction and discharge connections are in the lower half of the casing. The upper half is readily removable, giving full access to the revolving element. There are suitable openings for draining the pump and for displacing the air when starting. Inlet and outlet nozzles can be arranged either on the same or opposite sides, an important advantage where pumps are installed in limited space.

The shaft is made of high grade forged steel accurately machined and ground, and wherever it comes in contact with the fluid being pumped, it is thoroughly protected by bronze sleeves, which prevent the stuffing box packing from scoring the surface of the shaft. Each impeller is cast in one piece and is of the enclosed type. Surrounding each impeller hub is a pair of rings—one stationary, attached to the casing, and one revolving, attached to the impeller. By the use of double rings instead of a single ring, it is possible to restore the initial tightness of the joint between the low and high pressure sides of each stage without any fitting, whereas a new single ring would have to be of special diameter, and then fitted to the impeller hub, or the casing, to make a tight joint.

The diffusion ring surrounds the impeller at its periphery, although it is not in contact with it. It contains a series of openings, which receive the water from the impellers at high velocity and by means of gradually increasing area toward the periphery, reduce the velocity into pressure and enable it to advance to the entrance of the next impeller with much less loss of energy than would be the case if the high velocity of ejection were maintained.

To take care of thrust, which manifests itself in all multi-stage units, this pump is equipped with a simple internal hydraulic balancing device. This device consists of a revolving disc attached to the shaft at the inboard or high pressure end. Opposite this disc is a stationary drum of the same diameter. Water at high pressure connects with the space between the disc and the drum, causing the disc to react against the opposing thrust, neutralizing it and holding the rotor in proper relation to the casing. The slight leakage involved in this process is piped back to the suction.

On this pump there are two ring-oiled bearings, self-aligning, one located on each side of the casing. The bearing bodies are horizontally split, with removable caps, and the bushings are also split and lined with high-grade bearing metal. Bushings and bearing bodies have a spherical fit, automatically maintaining the alignment of the shaft. The bearings are of ample proportions to prevent heating, and the oil chamber is of liberal capacity. The bearings are supported by strongly ribbed brackets, cast integral with the lower casing, thus counteracting any possible tendency towards even slight vibration. These brackets are located sufficiently distant from the stuffing boxes to permit of adjustment of the glands. Felt washers are provided to prevent oil escaping from the bearings.

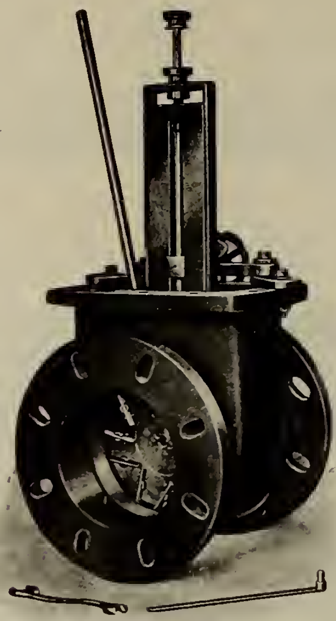


FIG. 2. FACING OFF GATE VALVE SEAT.

The stuffing boxes are deep and are provided with water seals, consisting of a lantern gland in each box connected to the water from the discharge side of the pump through a concealed passage, and so arranged that it can be readily cleaned. The stuffing box gland is fitted with swing bolts to give quick and easy access to the stuffing box.

When the pump is direct-connected, it is supplied with a shaft coupling of the flexible type to compensate for slight variation in alignment. The bed plate under the pump is of one piece box construction heavy enough to give a rigid support, and with cross ribs to prevent distortion. Fig. 2 shows this pump entirely assembled.

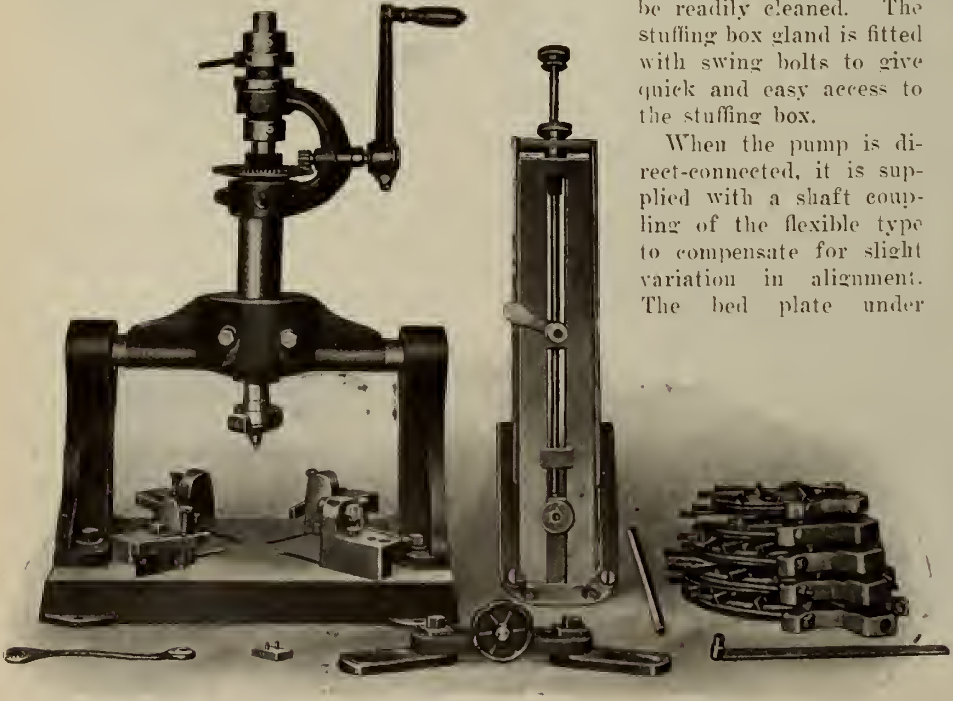


FIG. 1. COMPLETE GATE VALVE REFACING OUTFIT.

GATE VALVE RESEATING MACHINE

TO maintain the highest operation efficiency in any make of valve, the latter must have a perfect bearing on its seat to reduce to a minimum any possibility of leakage. Owing to the peculiar construction of gate valves, it is very difficult—without the aid of special equipment—to maintain them in good condition. To remove the seats from their fixed position requires considerable time and dexterity, often necessitating delay in the operation of the plant. However, mechanical appliances are constantly being designed and constructed which are gradually eliminating the difficulties incidental to water and steam valve operation.

The accompanying illustrations show the Dexter Gate Valve Re-seating Machine, as recently improved, for the more efficient handling of gate valve repairs. Fig. 1 shows a complete re-facing outfit. The part to the left indicates the rigid construction of the valve disc facing device; the base plate being supplied with four adjustable jaws for holding the work, while the facing tool is carried on the end of a revolving spindle. This spindle, as well as the device in which it operates, is similar to those used in the globe valve facing attachment. The section in the centre of the cut is the portion secured to the body of the valve while the cutters are operating on the interior valve seats. Fig. 2 is a view of the machine, in position, facing off a gate valve seat, while Fig. 3 illustrates the disc cutting device in operation. The various cutters are placed at different angles in relation to their travel, thus

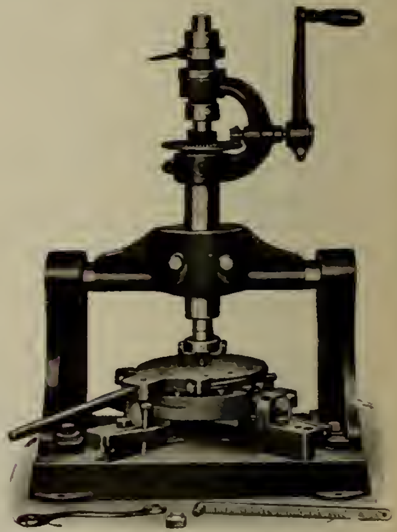


FIG. 3. DISC CUTTING DEVICE IN OPERATION.

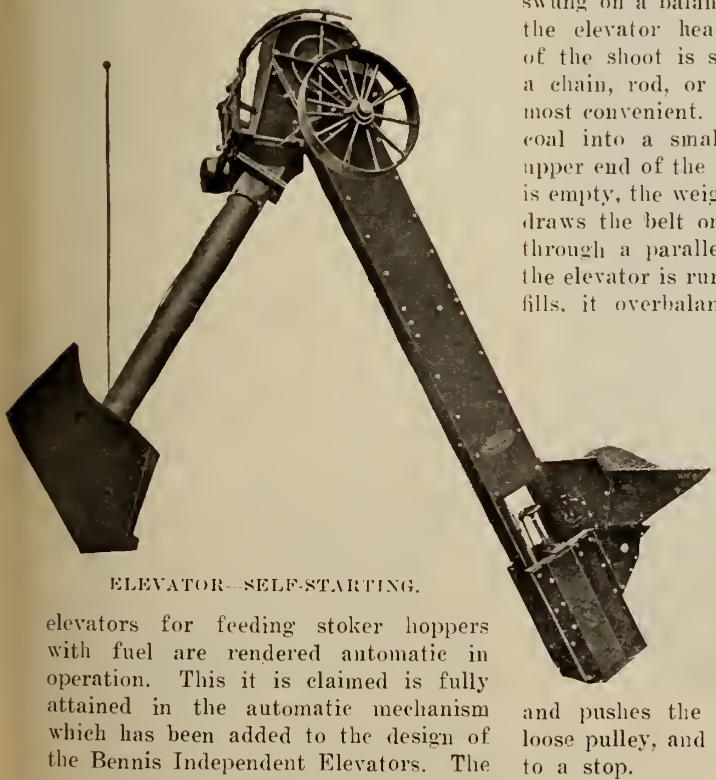
practically eliminating the possibility of chatter when cutting. The circular head which carries the cutters is operated by means of a flexible cable that grips the outer surface when moved in one direction, and releases when moved back again. By this method the cutters are forced to move continually in one direction, and can be operated successfully even when the lever has only a short travel.

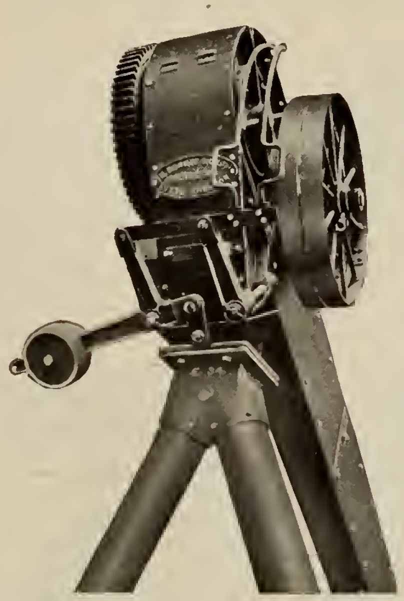
◆

SELF-STARTING AND SELF-STOPPING ELEVATORS.

THE shortage of labour which has been developing with increasing seriousness ever since the first day of the War, has now reached such a state of acuteness that manufacturers are literally tumbling over each other in their endeavors to find ways and means of overcoming the difficulty. The tendency to find efficient substitutes for manual labour, was of course in evidence long prior to the War, it being obvious to the more progressive manufacturers, that it was an economic gain to do as much work as possible with the expenditure of as little energy as possible. The War, merely intensified this tendency through the rapid and unexampled depletion of the reservoir of labour, with, as a corollary, the raising of its price to a point where it becomes a waste of national resources, to do by hand what can be done more cheaply and more efficiently by a machine.

Among many devices which have consequently come into favour as a factor in the efficient and economical working of boiler plants is that by which the elevators for feeding stoker hoppers with fuel are rendered automatic in operation. This it is claimed is fully attained in the automatic mechanism which has been added to the design of the Bennis Independent Elevators. The Bennis bucket elevator consists of a strong steel chain to which buckets are attached at regular intervals being kept in position by upper and lower guides. The buckets are formed of mild steel pressed out in one piece. The coal is fed into the elevator boot by means of the Bennis rotary safety feeder at a speed suitable for the buckets to take it up. This renders choking of the bucket by over-supply impossible, while it obviates any wrench on the chain.


ELEVATOR—SELF-STARTING.


ELEVATOR HEAD—RUNNING.

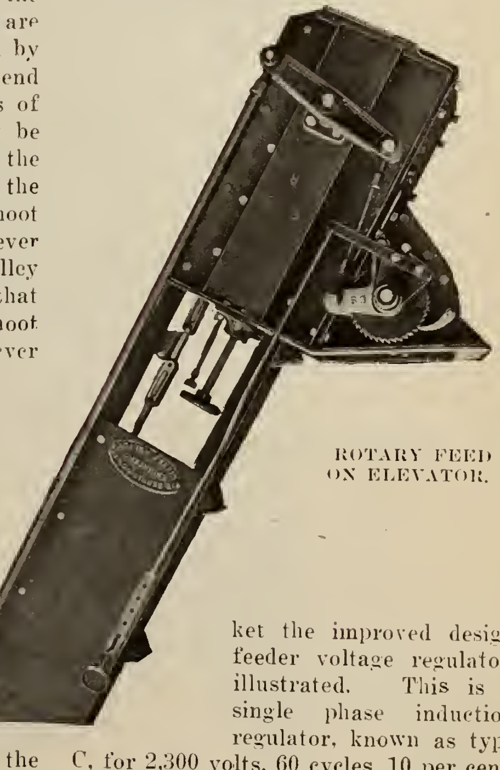
The automatic appliance which enhances the value and adds to the convenience of the elevator is quite simple. The shoots which feed the fuel from the elevator head to the hopper store are swung on a balanced lever supported by the elevator head, while the tail end of the shoot is supported by means of a chain, rod, or wire rope, as may be most convenient. The elevator feeds the coal into a small hopper forming the upper end of the shoot. When the shoot is empty, the weight on the balance lever draws the belt on to the driving pulley through a parallel link motion, so that the elevator is running. When the shoot fills, it overbalances the balance lever and pushes the strap fork on to the loose pulley, and the elevator is brought to a stop.

When the shoots are about half empty, the balance lever comes into operation again, and the elevator starts up. By this means there is always a sufficient supply of coal to keep the hoppers full, but the elevator is never allowed to overflow. The rate of revolution of the rotary feed can be altered by the raising or lowering of a handle. The device, details of which are shown in the accompanying illustrations can be applied to any existing elevator, whilst among other advantages, it may be mentioned that the elevator cannot overfeed the stoker hoppers; dribbling of fuel down the back of the elevator through overfeeding is thereby eliminated. Return shoots to the coal are rendered unnecessary. When the hoppers are full, the elevator stops running thereby greatly reducing wear and tear. The automatic action of the elevator renders an attendant unnecessary, while the operation is silent and smooth. Simplicity in design and strength of construction are prominent features of the apparatus which is manufactured by Ed. Bennis & Co., Little Hulton, Bolton, England.

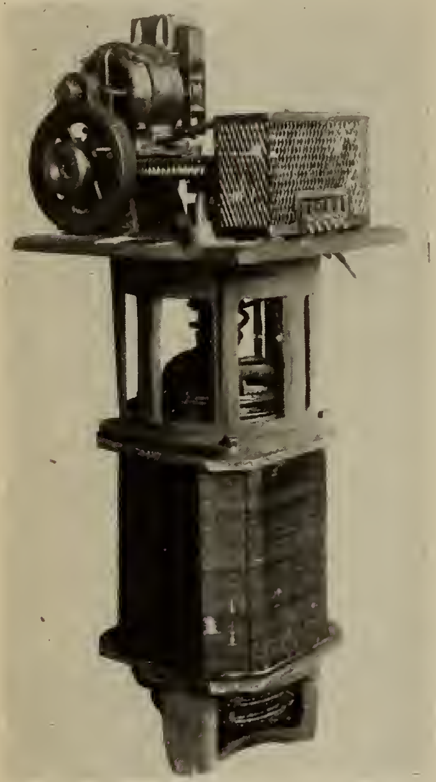
◆

IMPROVED DESIGN INDUCTION FEEDER VOLTAGE REGULATOR

AFTER a considerable amount of engineering and experimental work, with a view to improving the electrical performance and mechanical details, the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has placed on the market the improved design feeder voltage regulator, illustrated. This is a single phase induction regulator, known as type C, for 2,300 volts, 60 cycles, 10 per cent. regulation, and it is standardized in all ratings from 5¾ k.v.a. to 69 k.v.a. The


ROTARY FEED ON ELEVATOR.

refinements secured in this new design have increased the reliability of the regulator in service, and have simplified and decreased the expense of the wiring necessary for installing accessories for automatic operation, in addition to improving the electrical efficiency.



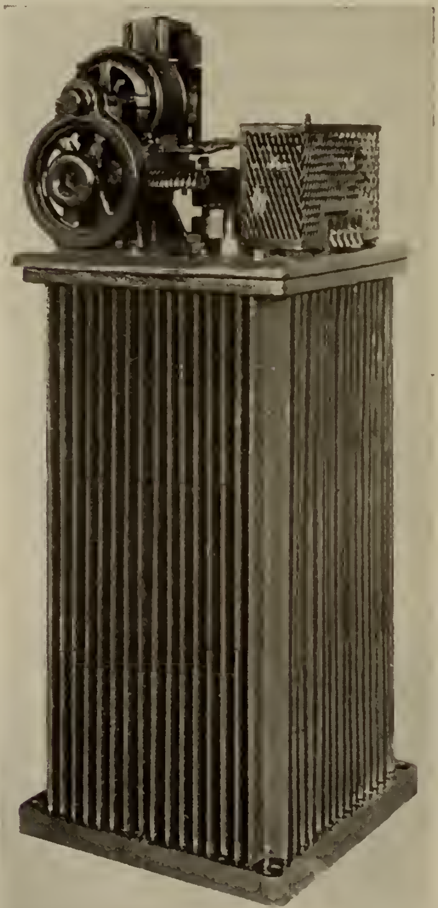
REGULATOR UNIT REMOVED FROM TANK.

The rotor is wound with form-wound coils, and constitutes the primary element. The short circuiting coils in the rotor are formed from a large number of turns of relatively small size enamelled copper wire, thus reducing the watts loss in these windings without decreasing the neutralizing effect for which they are provided. The stator core is of the frameless construction so largely used in induction motors. With this form of construction the cross section of the stator core is increased without a corresponding increase in size of other parts and of floor space, resulting in a decrease of iron loss and exciting current. Further, the insulating oil in which the regulator is immersed in the tank comes in direct contact with all surfaces of the stator core with more efficient cooling effect.

In a regulator the insulation of windings is of vital importance because of the severe conditions of operation. The coils for both primary and secondary are, therefore, carefully insulated and impregnated, and are assembled in open slots. They are held by fibre wedges driven in small grooves at the top edges of the slots. Heavily insulated steel bracing rings are assembled around the exposed ends of the stator coils at both ends of the core. These rings are bound to the coils with cord, and greatly stiffen the coils against distortion from mechanical shock caused by current surges in the feeder during periods of line disturbance or short circuit. This feature is an important one, increasing the protection to the coil insulation and the factor of safety of the regulator in service.

An electrically controlled switch or auxiliary relay for the operating motor, formerly mounted separately from the regulator, is now mounted directly on the regulator top cover and includes the limit switch. This arrangement cuts down the number of wires required in the control circuit for automatic operation, and simplifies and lessens the expense of installation. The chance of failure in the control circuit is correspondingly lessened as well, and inspection of the wiring is made easy. The operating motor is provided with a quick acting magnetic brake as heretofore, but the operating mechanism has been changed, so that the regulator now requires only ten seconds for the complete range of travel from maximum buck to maximum boost, 20 per cent. regulation.

The regulator is made as a unit, and may be quickly removed from the tank by simply unbolting the top cover, thus making inspection and repairs comparatively simple. The tank is formed from sheet steel walls with oxy-acetylene welded seams, and with top and bottom flanges cast on to the walls. This type of tank is the same as that used with Westinghouse oil insulated self-cooled transformers. It is strong without undue weight, and free from oil leakage. The radiation quality is necessarily very high.

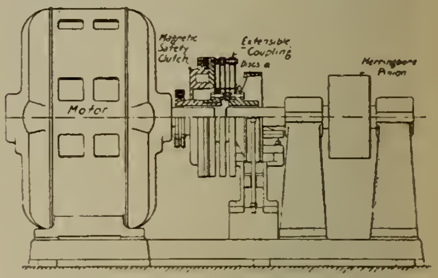


COMPLETE APPARATUS WITH REGULATOR UNIT IN POSITION.

* * *

EXTENSIBLE COUPLING FOR MILL DRIVES.

THE Cutler-Hammer Clutch Co., Milwaukee, Wis., has developed a new type of coupling for use with mill drives, particularly where herringbone gears are used. The extensibility of the coupling is independent of the amount of torque transmitted and is the same at no load as when full power is being transmitted. A certain amount of flexibility is also present in the clutch and this too is not affected by the amount of torque transmitted. The coupling was designed for use with a set of rubber calendar rolls but, it is pointed out, is capable of a number of other applications where an extensible coupling is desired. In designing this coupling three factors had to be taken into consideration. The coupling must transmit the necessary power between the motor and the herringbone driving pinion and at the same time leave the latter free to align itself with the gear with which it meshes and also not transmit any end thrust caused by the lateral motion of the driving shaft to the pinion.



EXTENSIBLE COUPLING FOR MILL DRIVES.

The construction of the coupling is simple, consisting of a number of thin disks bolted together to form the disks of the coupling. The use of thin disks was decided upon as the deflection of a thin circular plate under a given load varies inversely as the cube of the thickness. While the torque transmitted by the single disk 3/8 in. thick is the same as that transmitted by three 1/8-in. disks, the flexibility of the latter combination is nine times that of the former. In this coupling, which is 32 in. in diameter, it is stated that the correctness of this theory has been satisfactorily demonstrated, the force necessary to cause a deflection of almost 1 in. being much less than the end sliding friction in the bearings.

"Fairbanks Valves Are My Choice"

Such is the opinion of every engineer who has given them a fair test. They are conservatively made; are heavier than the corresponding standard and heavy weights.

They are built to give the utmost service, and are fitted with

Renewable Bakelite Discs

These discs can be replaced in less than a minute, without removing the valve from the line, and without the use of a single tool except a wrench to unscrew the valve bonnet. Bakelite Discs have been proven by many experiments to have the longest life of any disc on the market.

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The valve stems are packed with "Palmetto Twist."

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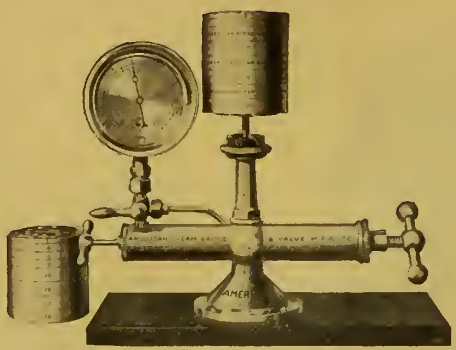

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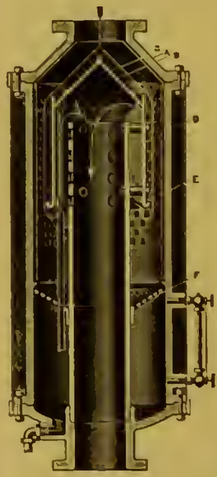
III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.



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III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

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You, too, will find that G & K Belting is more than just good belting, that it incorporates the quality, strength, pliability, and firmness, so essential to the day-in and day-out efficient transmission of power. You will find a brand for every drive, every condition of service,—you will find the belt especially suited to your requirements.

Catalog, Samples, Engineering Advice, and complete details furnished cheerfully upon request. May we assist you toward Continuous Belting Service?

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is made and kept soft in each single strand by our own special process of thorough lubrication.

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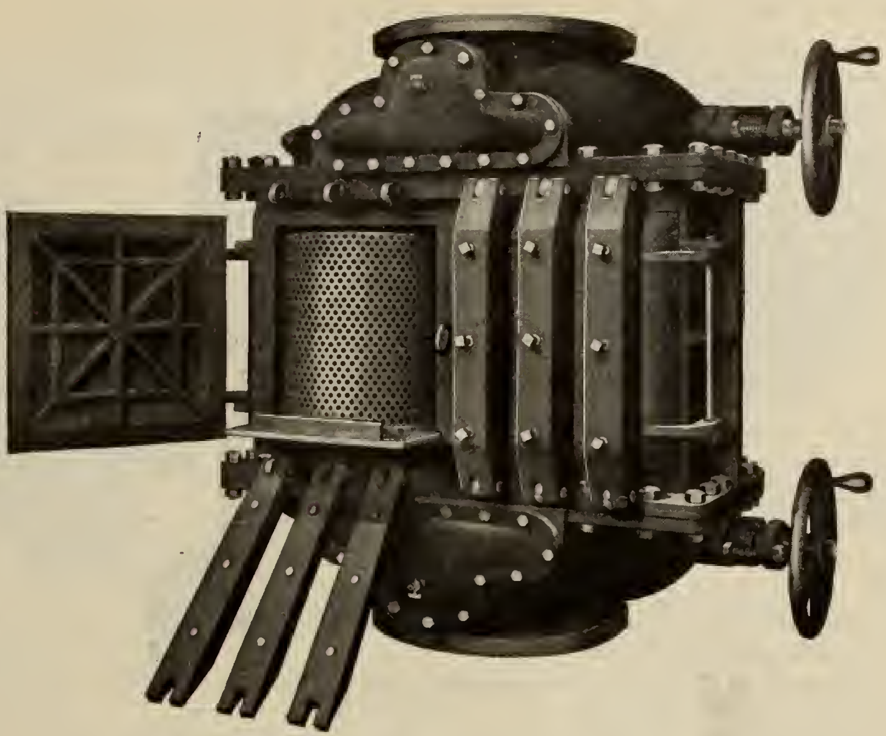
TWINS



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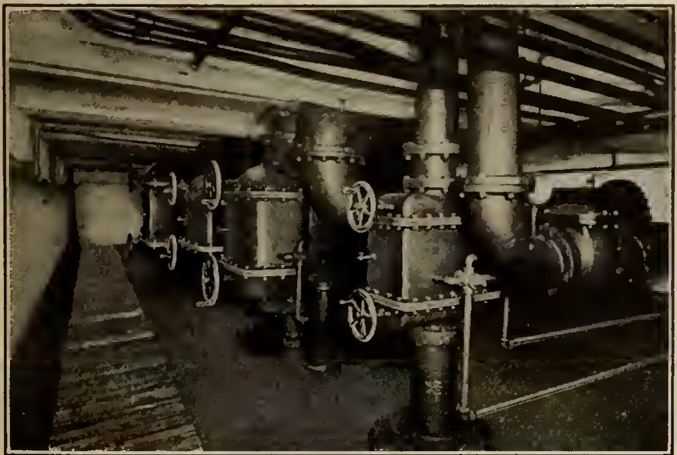
This statement by the Master Mechanic of a large iron and steel company, almost staggered our salesman—it gave him a new angle on the product he was selling.

He knew that Twin Strainers effected a great saving by preventing the clogging up of apparatus and the consequent shutting down of equipment. He knew their lasting qualities and of instances where they had gone 15 years without repairs, but as to the saving made on the upkeep of the equipment protected—well, it certainly was a new idea.

Perhaps our Bulletin will make a similar impression on you—will you send for a copy?

A typical installation showing one 8, two 16 and one 24-inch TWIN STRAINER. Every intake line is protected.



ELLIOTT COMPANY

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If any advertisement interests you, tear it out now and place with letters to be answered.

A SPRINKLER STOKER WITH ROTARY DISTRIBUTOR

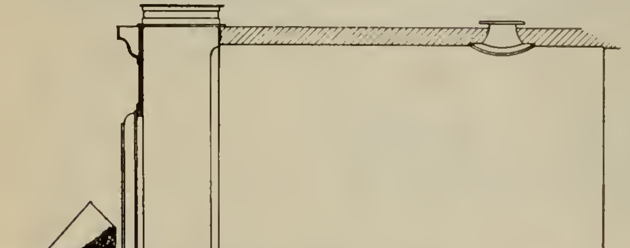
A MECHANICAL stoker of the sprinkler type, combining novel features tending toward simplicity and reliability of working, has been placed on the market by the Galt Foundry Co., Galt, Ont. The apparatus is known as the Galt Sprinkler Stoker, and is specially designed to feed and spread the coal continuously over the grates, as opposed to the intermittent methods of hand firing, or to the practice of dividing the furnace chamber into zones — coking and ash belts.

The stoker is entirely self-contained, being assembled on a frame casting which hangs upon the boiler front in place of the regular fire-door, the feeding mechanism covering only a narrow space across the upper part of the fire-door opening. A fire-door is fitted in the supporting frame, giving access to the furnace at all times.

Situated above the feeding mechanism is a feed hopper having a capacity of about 300 lbs. of fuel, which can be conveniently detached when required for access to the flues and tubes. The fuel in the hopper is drawn down and moved across the bed plate of the stoker by the reciprocating motion of the feed plate produced by means of the rocker arms shown in sectional illustration, these arms in turn being actuated by a rocker arm connected to an eccentric on the main shaft, the rate of feed being controlled by a hand wheel.

The spreading of the fuel over the grate surface is accomplished by means of the rotary stoker or feeding device, which is operated independently of the feed regulating device, and at a constant speed which can be adjusted for different depths of grates. As the fuel is forced over the edge of the bed plate it falls on a curved plate or tray where it is caught by the revolving blades and thrown into the furnace. The revolving blades have an alternate helical face which spreads the fuel successively to either side so that even distribution of the fuel is accomplished.

FIRE DOOR GIVES FREE ACCESS TO FIRE AT ALL TIMES.



SECTIONAL VIEW OF FURNACE SHOWING FEEDING AND DISTRIBUTION OF FUEL.

These distributor blades are heavy steel castings freely suspended, so that, when operating, they are held in position by centrifugal force, and thus may yield if an unusual obstruction is encountered.

All rotating shafts on the stoker are carried in removable bronze bushed bearings. The distributor and eccentric shafts are driven by heavy roller chain of ample size running on machine cut sprockets. The self-contained fire-door is of ample proportions for hand-firing in case of emergency, or for regular banking of the fires, which can be done without interruption to the working of the mechanism.

* * *

A saw belted direct from a 7 horse-power motor would not rip anything. A 10 horse-power motor was put in, but the machine still refused to work. It was a large self-feed saw with pulley on arbor for an 8-inch belt. A 7-inch belt was being used. To save the motor, the 7-inch belt was taken off and replaced by a 4-inch one. The saw now works well. The motor would not stand the sudden jerks sent to it by the wide belt.

Trade Gossip

Montreal, Que.—Armour & Co. will build a packing plant and power house here.

Major William Ashplant, formerly city engineer of London, Ont., has been wounded in France.

Vancouver, B.C.—The management of the Hotel Vancouver here have decided to instal a power plant.

Halifax, N.S.—The City Council contemplate the construction of an abatoir at an estimated cost of $25,000.

St. John, N.B.—The Governors of the General Hospital here contemplate building a laundry and power house.

Aylmer, Que.—The Town Council have decided to call new tenders for the proposal filtration plant, the recent bids having been rejected.

Maillardville, B.C.—A waterworks system will be installed here. F. L. Macpherson, engineer of Burnaby, B.C., has charge of the work.

SELF-CONTAINED STOKER REPLACES THE REGULAR FIRE-DOOR.

Lieut. A. W. McKnight, late town engineer at Port Moody, B.C., has been killed in action. He was born 27 years ago at Owen Sound Ont.

St. Thomas, Ont.—The Monarch Knitting Co., will build an extension to the power plant and factory. T. O. Aked is the manager.

Nelson, B.C.—The West Kootenay Power & Light Co. will construct an 8,000-horsepower unit addition to its plant at Upper Bonnington Falls.

St. Marys, Ont—The Town Council are considering the installation of an auxiliary gasoline waterworks plant at an approximate cost of $4,000.

Bawden Basket Strainers

Save Your Pump Valves

BAWDEN NEVER SHORT STROKE PUMPS

Keep Your Water Lines Clean

Write for Catalogue and Prices.

Pumps For All Purposes

A Bawden Basket Strainer should be on every pump suction. It will catch all the dirt and is easily cleaned by emptying the basket.

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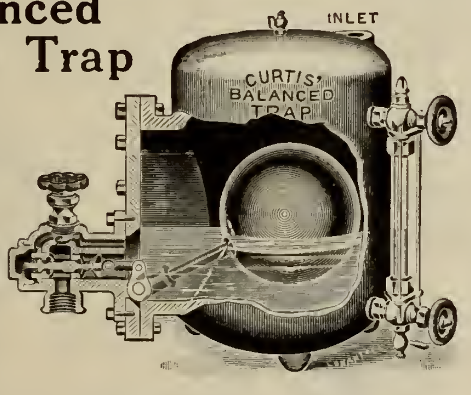
CURTIS Engineering Specialties

Balanced Steam Trap



This trap is often used as a waterline trap on large plants where there is need to balance any particular circulation to prevent snapping and cracking in pipes and radiators.

This Trap Has These Points of Difference and Superiority

1—A perfectly balanced valve.
2—An absolutely frictionless valve.
3—The valve can be removed without breaking a joint, starting a gasket, or taking out a bolt.
4—The valve being frictionless and balanced, the whole power of the float is available for opening and closing the valve.
5—Each trap will operate perfectly on pressure varying from one to 250 lbs.

The great merit of this trap, its simplicity, its dependability and serviceability make it well worth being better acquainted with. Send for special printed matter describing it and giving prices. Address the Manufacturers.

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Sturtevant
(REG. CAN. PAT. OFF.)

Turbovane Fan

The Sturtevant Turbovane Fan is the latest thing for forced draft work.

It is adapted for the range of pressures usually present in underfeed stoker installations.

Furthermore, this fan is designed to run at the economical speeds of Sturtevant Turbines. For this reason the unit is an absolutely unique proposition for forced draft. It is a combination that no other manufacturer builds.

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Ask for full information — or would you like our engineer to call?

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Catalogues

Belts, the house organ of the Federal Engineering Co., Toronto, contains in the August issue, humorous stories and some interesting matter relative to belting.

The Gray Mfg. & Machine Co., Toronto, are distributing to the trade a new bulletin No. 14, dealing with the "Gray" power pumps and water supply systems. The bulletin contains a brief description of the systems and specifications covering the various sizes of pumps and tanks, etc., with price list. The bulletin is illustrated.

Water Lift Pump.—The Buckeye Pump Mfg. Co., Columbus, Ohio, have issued a folder containing suggestions for installing the "Buckeye" water lift pump, together with a diagram showing the necessary piping and connections for a typical installation. A sectional view of the pump is included showing its construction, accompanied by a table giving the principal dimensions of the various sizes.

Pumping Machinery.—Catalogue No. 29 deals with an interesting line of pumping machinery and air compressors made by the National Steam Pump Co., Upper Sandusky, Ohio. Simplex and duplex pumps for a large variety of purposes, also vacuum pumps, are dealt with, while automatic feed pumps and receivers and air compressors are also included. A general description is given of each type, with special reference to the principal features embodied in their construction. Each type of equipment is illustrated, and tables are included giving the principal dimensions and capacity of each size. The catalogue concludes with a list of parts for several types of pumps, accompanied by diagrams.

High Pressure Tanks.—The Wm. B. Scairfe & Sons Co., Pittsburg, Pa., have recently issued a catalogue dealing with their line of copper brazed high pressure tanks for air, gas and liquids. The construction of these tanks is described, followed by a general specification and tables, giving the working pressures and dimensions for painted and galvanized pressure tanks. One section of the catalogue illustrates and describes brazed and riveted pneumatic tanks for a variety of purposes, and include tables giving the capacity, weight and prices of the various sizes of each type. Another section deals in the same way with garage air and gasoline tanks. The concluding section illustrates and describes a line of range boilers.

Portable Conveyers. — Bulletin No. 184, just off the press, features an interesting line of portable conveyors and stackers for handling barrels, bags, boxes and miscellaneous packages, made by the Jeffrey Mfg. Co. The equipments illustrated and described in this bulletin are adapted to a wide range of industries, such as bakeries, breweries, cement mills, flour mills, glue factories, paint works, salt works, sugar refineries, warehouses, docks and storage where large quantities of material are handled in packed form; for stacking purposes, for loading material into shipping platforms, into freight cars, etc. Free copies may be obtained by interested persons, by addressing the Canadian office of the Jeffrey Mfg. Co., Power Building, Montreal, Que.

Pumps. — Bulletin, series G, No. 1 deals with the "Wood" screw type pump made by the D'Oliver Centrifugal Pump and Machine Co., Philadelphia, Pa. These pumps which are designed for irrigation and drainage service are described fully, special mention being made of their principal features while the advantages of the "Wood" screw type of pump are dealt with in detail. Results of tests are included with curves and illustrations.

The National Steam Pump Co., Upper Sandusky, Ohio, have issued two bulletins No. 20 and No. 21 dealing respectively with the "National" boiler feed pump and outside packed plunger pump. In addition to a general description of each type of pump the bulletins feature the balanced piston valve. The operation of this valve is fully described and a sectional drawing shows the general arrangement and its application. The principal dimensions and capacity of the various sizes of each type of pump are given.

Refrigerating Machines—Bulletin No. 42 A, deals with vertical enclosed single-acting ice making and refrigerating machines built by the York Manufacturing Co., York, Pa. The bulletin contains a detailed description of the "York" refrigerating machine accompanied by illustrations showing the various types and sectional views showing the general arrangement. A description is given of the evaporating system with diagrams showing plant layouts. Copies of this bulletin may be obtained from the Canadian Ice Machine Co., Toronto, selling agents for the "York" machines.

Steam Traps. — Bulletin "C" describes and illustrates the "Marck Therm" steam trap made by the E. F. Houghton & Co., Philadelphia Pa. The bulletin deals fully with the possibilities of the application of this trap to the automatic discharge of condensation from steam pipes, radiators and low pressure steam services generally. The application, construction and operation of this trap are described in a comprehensive manner while illustrations show the trap itself and also its application under various conditions. Interested readers may obtain copies of this bulletin by writing.

Auto Starters for squirrel-cage induction motors are the subject of circular No. H—7001 issued by the Canadian Westinghouse Co., Hamilton, Ont. The construction and principal features of these auto-starters are described fully,

Electric Motors.—T. W. Broadbent Ltd., Huddersfield, England, have recently issued leaflet No. 3 of catalogue No. 5, dealing with their "M" type continuous current motors. The leaflet contains a specification covering the principal features of these motors together with illustrations while price tests and shipping weights are included for the various sizes. Copies of the leaflet may be had on application.

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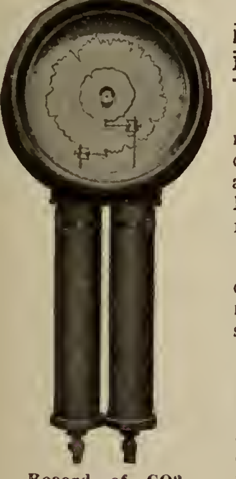

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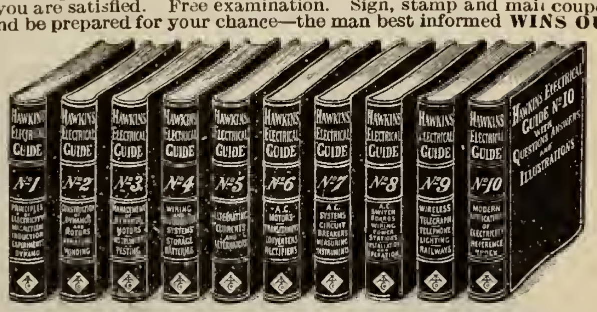

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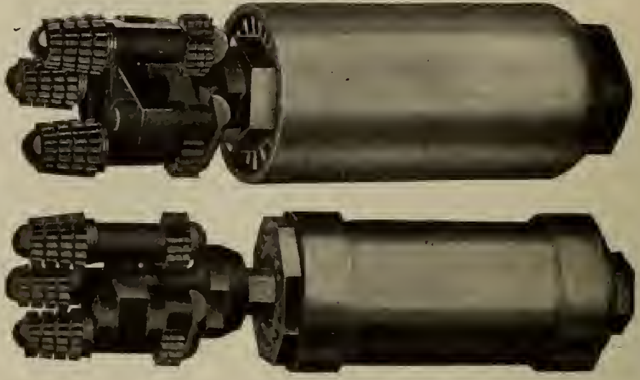

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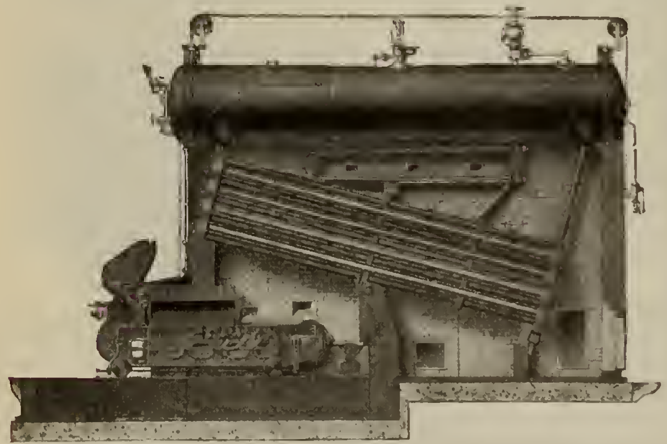

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John MacDougall Caledonian Iron Works, Montreal.

ELEVATING MACHINERY
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Goldie & McCulloch Co., Galt.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

ENGINEERS' SUPPLIES
Darling Bros., Ltd., Montreal, Que.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.

ENGINES, AUTOMATIC AND DROP VALVE
Frick Co., Waynesboro, Franklin Co., Pa.
MacKinnon, Holmes & Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

ENGINES, CORLISS AND ROCKING VALVE
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford.

ENGINES, GAS AND GASOLINE
Boving Hydraulic & Eng. Co., Lindsay, Ont.
Laurie & Lamb, Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.

ENGINES, HIGH SPEED, STEAM
Belliss & Morcom, Birmingham, Eng.
Canadian Griscom-Russell Co., Ltd., Montreal.
Can. Sirocco Co., Windsor, Ont.
Goldie & McCulloch Co., Galt.
Laurie & Lamb, Montreal.
John MacDougall Caledonian Iron Works, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, MARINE
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works. Co., Ltd., Montreal.

ENGINES, SAW MILL
Goldie & McCulloch Co., Galt.
Wm. Hamilton Company, Ltd., Peterborough, Ont.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
Waterous Engine Works Co., Brantford.

ENGINES, SINGLE, COMPOUND AND TRIPLE EXPANSION
Canadian Griscom-Russell Co., Ltd., Montreal.
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.
Kerr Engine Co., Walkerville.
Waterous Engine Works Co., Brantford.

ENGINES, VERTICAL
Laurie & Lamb, Montreal.

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Terry Steam Turbine Co., Hartford, Conn.

EXHAUST HEADS
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Darling Bros., Montreal.
Direct Separator Co., Syracuse, N.Y.
Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Jas Morrison Brass Mfg. Co., Toronto.
Terry Steam Turbine Co., Hartford, Conn.
Watson & McDaniel Co., Philadelphia.

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Direct Separator Co., Syracuse, N.Y.
Howard Iron Works, Buffalo, N.Y.
Lunkenheimer Co., Cincinnati, O.

FANS, STEAM TURBO
Hare Engineering Co., Toronto.

FANS, VENTILATING
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Coppus Engr. & Equip. Co., Worcester, Mass.
B. F. Sturtevant Co., Boston, Mass.

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Alberger Heater Co., Buffalo, N.Y.
Babcock & Wilcox, Montreal.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Canadian Griscom-Russell Co., Ltd., Montreal.
George W. Cole Co., Toronto.
Darling Bros., Montreal.
Elliott Co., Pittsburgh, Pa.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.

FEED WATER PURIFIERS
Stewart Heater Co., Buffalo, N.Y.

FEED WATER REGULATORS
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Chapin & Fulton Mfg. Co., Pittsburg, Pa.
Geo W. Cole Co., Toronto.
Elliott Co., Pittsburgh, Pa.
Laurie & Lamb, Montreal.
S-S Regulator Co., Fostoria, Ohio.

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Bowser & Co., Inc., S. F., Toronto, Ont.
Laurie & Lamb, Montreal.
John McDougall Caledonian Iron Works, Montreal.

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Darling Bros., Ltd., Montreal, Que.
Frick Co., Waynesboro, Franklin Co., Pa.
York Manufacturing Co., York, Pa.

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Quaker City Rubber Co., Philadelphia, Pa.

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FLANGED STEAM FITTINGS
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FLANGES
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Lunkenheimer Co., Cincinnati, O.

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Liberty Mfg. Co., Pittsburg, Pa.
William B. Pierece Co., Buffalo, N.Y.
Roto Co., Hartford, Conn.

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Uehling Instrument Co., New York.

FLUMES, STEEL
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FRICTION LEATHERS
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FURNACES, SMOKELESS
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Ed. Bennis & Co., Little Hulton, Bolton, Eng.
Detroit Stoker Co., Detroit, Mich.
Jones Underfeed Stoker Co., Toronto.
Murphy Iron Works, Detroit, Mich.
Geo. H. Tod, Toronto.

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Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y

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Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
Peerless Rubber Mfg. Co., New York, N.Y.

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Laurie & Lamb, Montreal.

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Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto.
W. J. Wall, Montreal.
Garlock Packing Co., Hamilton, Ont.
S-C Regulator Co., Fostoria, Ohio.

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Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y

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Foxboro Company, Foxboro, Mass.
Lunkenheimer Co., Cincinnati, O.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.

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Babcock & Wilcox, Montreal.
Jenkins Bros., Ltd., Montreal.
Lunkenheimer Co., Cincinnati, O.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

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Smart-Turner Machine Co., Ltd., Hamilton.

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Laurie & Lamb, Montreal.

GENERATORS AND CONVERTORS
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GRAPHITOL
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Shell Bar Grate Co., Toronto, Ont.
Geo. H. Tod, Toronto.
Waterous Engine Works Co., Brantford.

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Hamilton Brass Mfg. Co., Hamilton, Ont.
Lunkenheimer Co., Cincinnati, O.
Jas. Morrison Brass Mfg. Co., Toronto

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Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Laurie & Lamb, Montreal.
C. C. Snowdon, Calgary.

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Canadian Fairbanks-Morse Co., Ltd., Montreal.
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C. C. Snowdon, Calgary.

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NOTICE

To Manufacturers, Dealers and Users of Steam Boilers

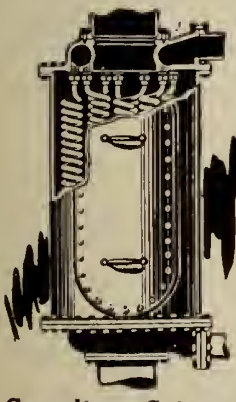
All steam boilers built in, or entering the Province of Ontario, and boilers exchanged or repaired are subject to Government Inspection as prescribed in the Steam Boilers Act, 3 George V., C. 61.

Before any work of repair or alteration is commenced on any boiler, notice must be sent to the Department, stating the nature and extent of the repairs or alterations proposed to be made. If the Chief Inspector should consider such repairs or alterations of an extensive character, the boiler must be inspected in accordance with the Regulations by an Inspector authorized under the Act.

All communications should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G. MACDIARMID, Minister of Public Works.

D. M. MEDCALF, Chief Inspector of Steam Boilers.



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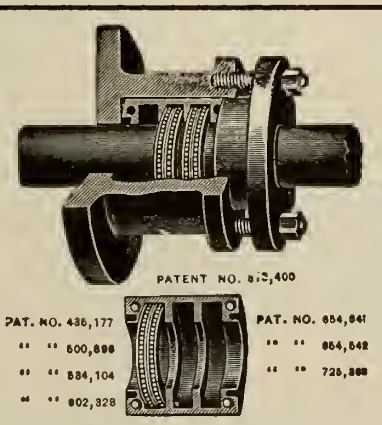

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Holmes Metallic Packing Co., Wilkes-Barre, Pa.

NOTICE TO Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

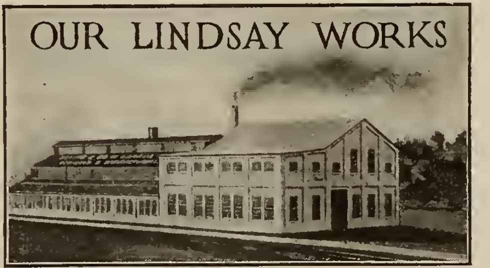
Everyone operating a HOISTING steam plant working at a pressure of 30 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways.

W. C. McGHIE, Chairman of Board.

Water Turbines, Hydraulic Governors, Centrifugal Pumps



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Jos. Dixon Crucible Co., Jersey City.
C. C. Snowdon, Calgary.

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Lunkenheimer Co., Cincinnati, O.

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Lunkenheimer Co., Cincinnati, O.

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Can. Detroit Lubricator Co., Walkerville, Ont.
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Lunkenheimer Co., Cincinnati, O.

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Murphy Iron Works, Detroit, Mich.
Geo H. Tod, Toronto.

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Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

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Canadian Griscom-Russell Co., Ltd., Montreal.
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Darling Bros., Montreal.
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Elliott Co., Pittsburgh, Pa.
Hare Engineering Co., Toronto.
Liberty Mfg. Co., Pittsburgh.
Jas. Morrison Brass Mfg. Co., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.

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Garlock Packing Co., Hamilton, Ont.
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Garlock Packing Co., Hamilton, Ont.
Greene, Tweed & Co., New York.
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York Mfg. Co., York, Pa.

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The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Ltd., Hamilton.
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Garlock Packing Co., Hamilton, Canada.
Laurie & Lamb, Montreal.
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Jeffrey Manufacturing Co., Montreal.
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MacGovern & Co., New York.
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Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

PULP MILL MACHINERY
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Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Jeffrey Manufacturing Co., Montreal.
Waterous Engine Works Co., Brantford.

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American Steam Pump Co., Battle Creek, Mich.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont.
Bawden Machine Co., Ltd., Toronto.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Ltd., Hamilton.
Terry Steam Turbine Co., Hartford, Conn.
Waterous Engine Works Co., Brantford.

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Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Jeffrey Manufacturing Co., Montreal.
Storey Pump & Equipment Co., Ltd., Toronto.
Smart-Turner Machine Co., Hamilton, Ont.
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Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
Watson & McDaniel Co., Philadelphia.

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Bawden Machine Co., Ltd., Toronto.
Boving Hydraulic & Eng. Co., Ltd., Lindsay, Ont
Darling Bros., Ltd., Montreal, Que.
Liberty Mfg. Co., Pittsburgh, Pa.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.

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American Steam Pump Co., Battle Creek, Mich.
Bawden Machine Co., Ltd., Toronto.
Canadian Fairbanks-Morse Co., Ltd., Montreal.
Darling Bros., Ltd., Montreal, Que.
Laurie & Lamb, Montreal.
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.
Smart-Turner Machine Co., Hamilton, Ont.
Storey Pump & Equipment Co., Ltd., Toronto.
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The superiority of the "Spraco" System over a cooling tower system is emphasized by their installations in over 250 progressive power plants where they are rapidly replacing many cooling tower equipments. We are engineers as well as manufacturers, and our system is installed to suit your particular needs after a careful and scientific study of your individual problem.

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The Goldie-McCulloch Co., Ltd.
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Owners and manufacturers for the United States.

Write for Bulletin No. 16.

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FOR HIGH OR LOW PRESSURE.

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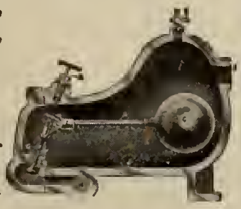

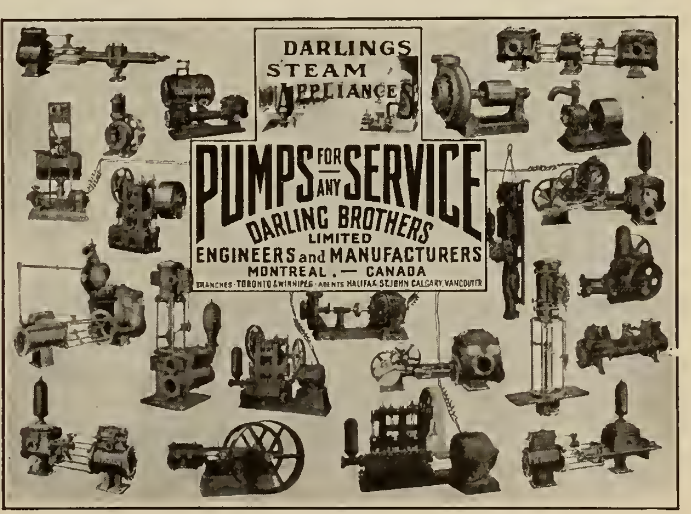

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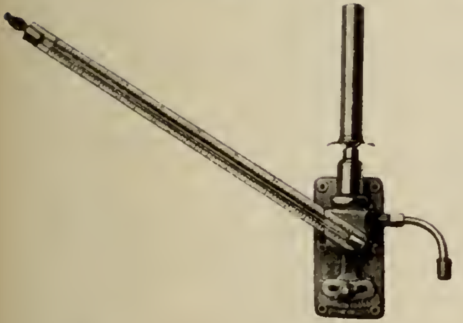

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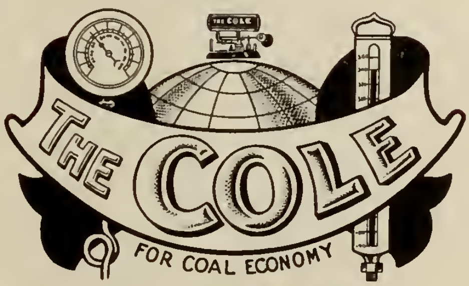

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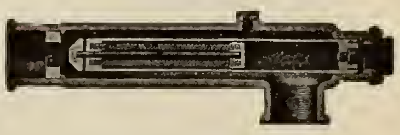

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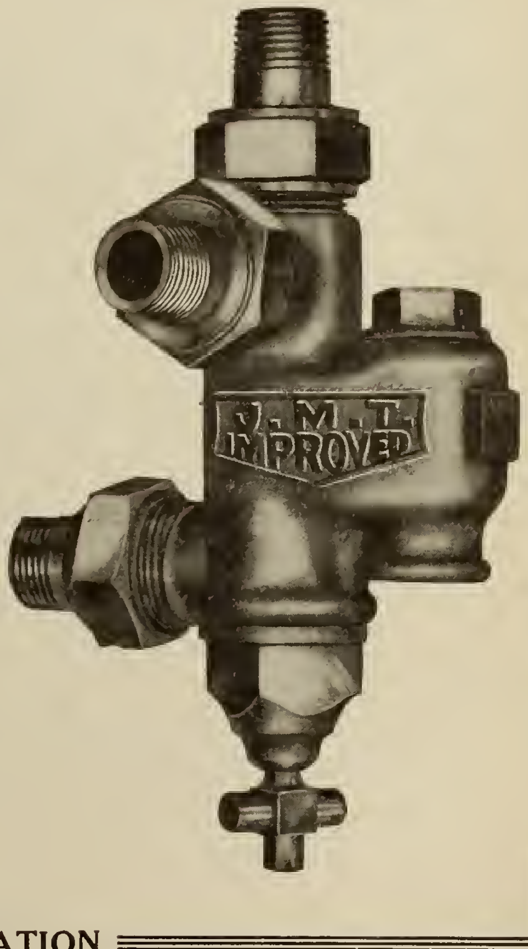

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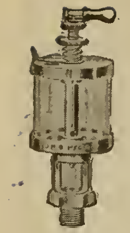

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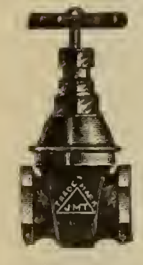

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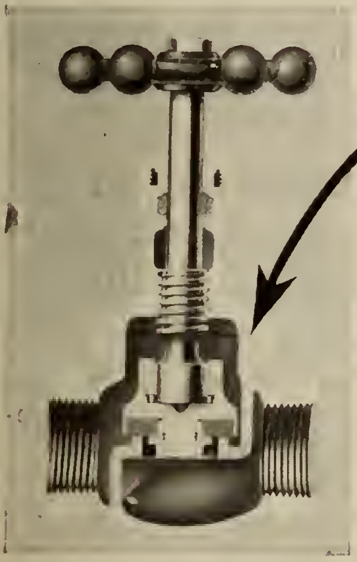

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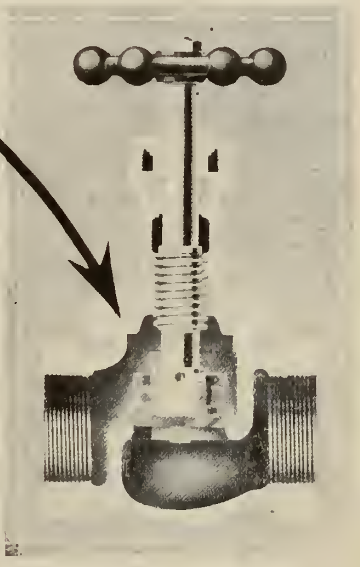

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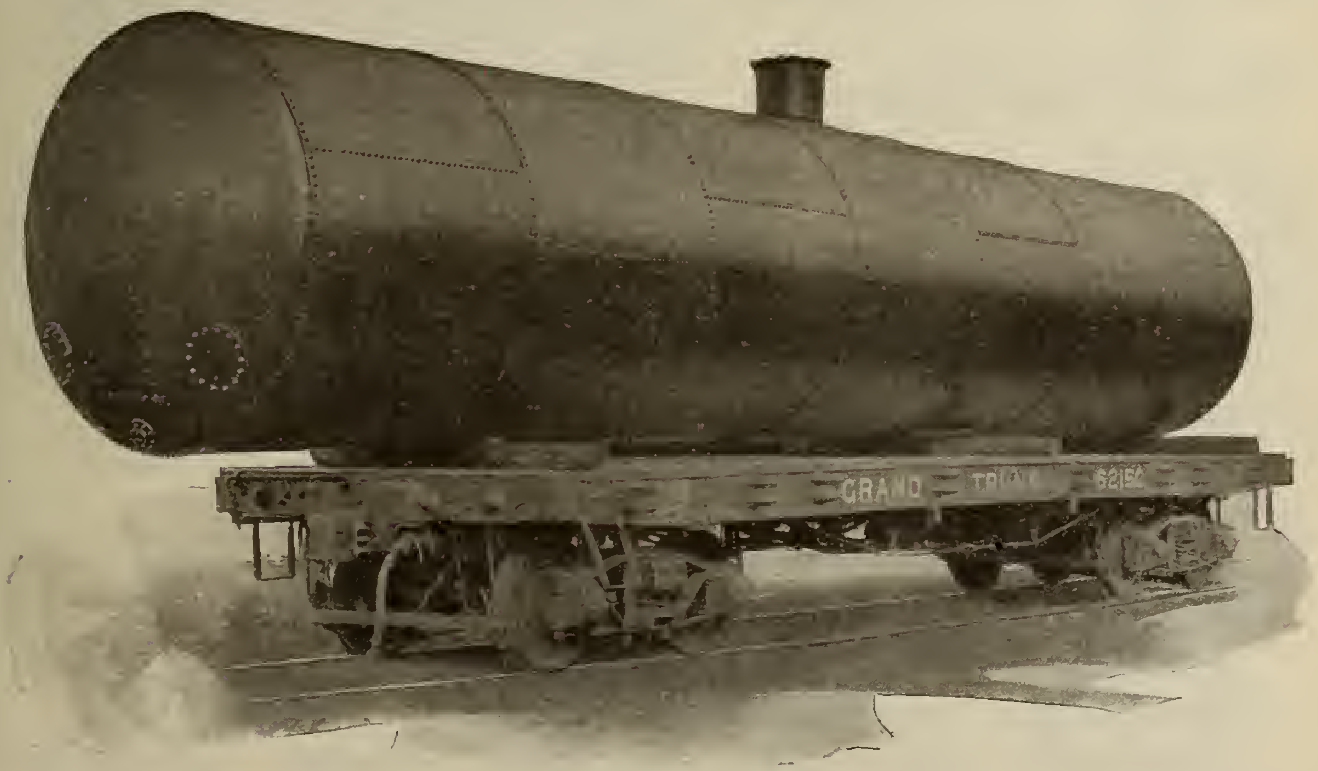

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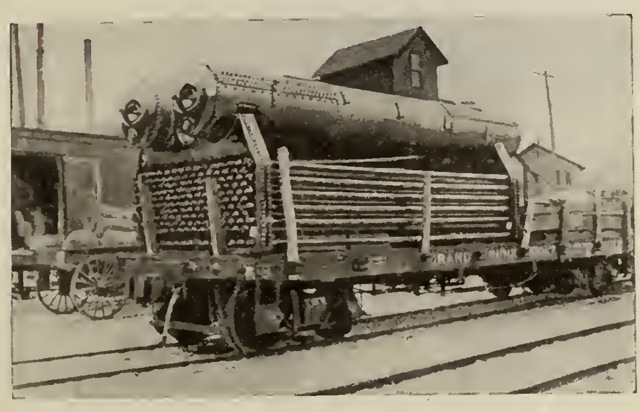

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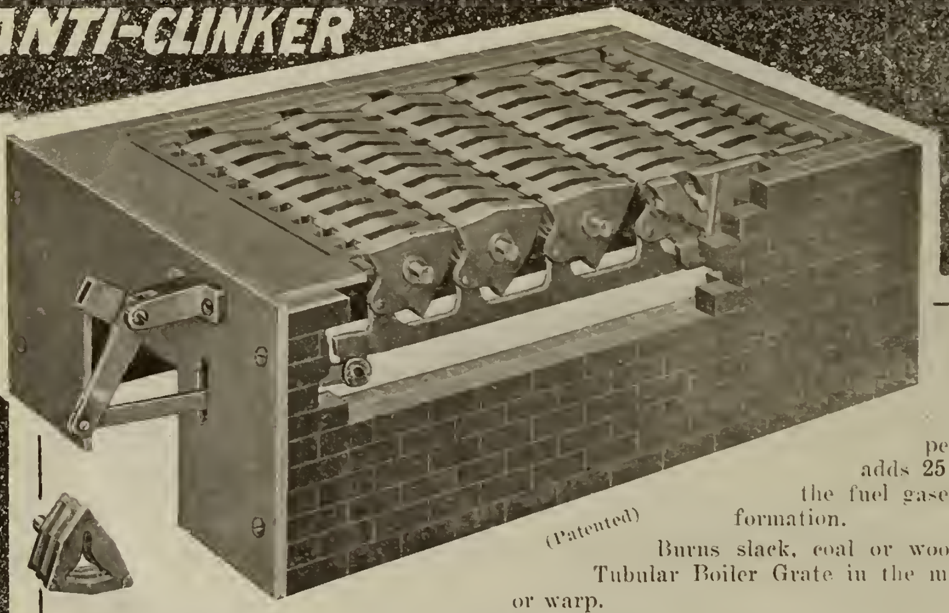

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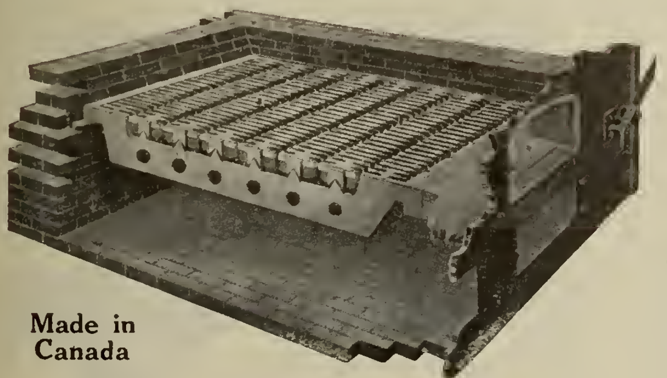

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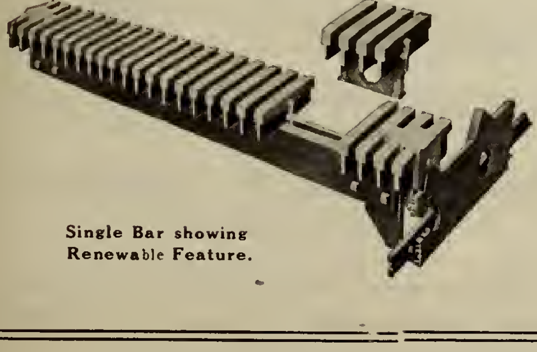

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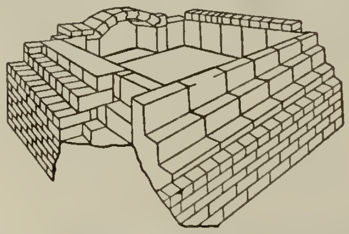

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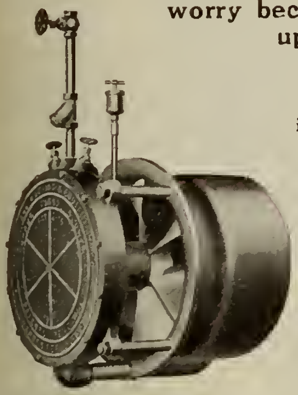

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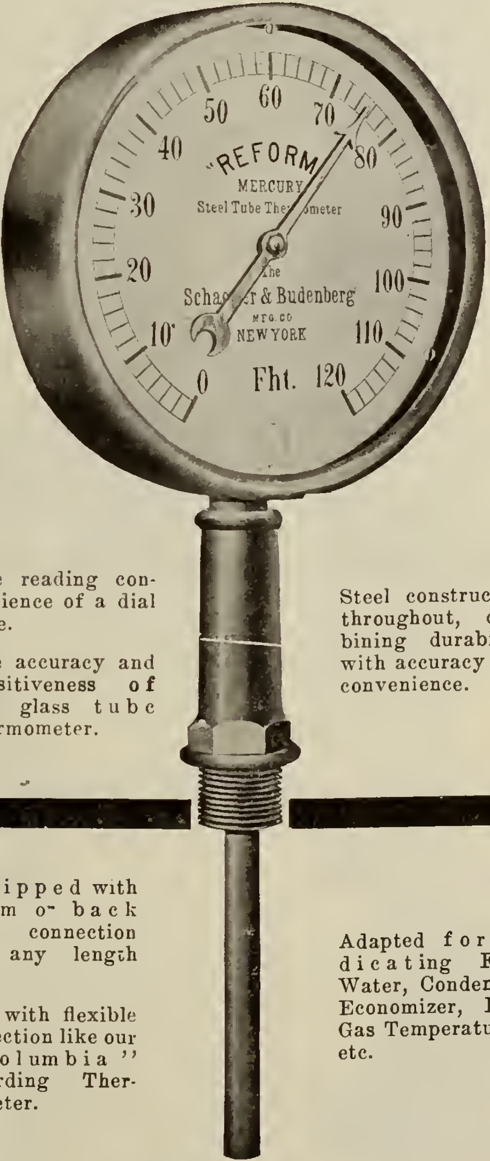

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If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the " Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

DART

Efficiency That's Permanent

Nothing to deteriorate, sure joint every time, easily installed. Heavy iron parts will not stretch or pull apart.

NO UPKEEP COST
NO REPLACEMENT COST
NO LOSS FROM LEAKS

Full sized opening through the union, no recess or obstruction to hinder flow.

Easily installed whether pipes are in or out of line. All threads are exact to the standard and are clean and full.

YOUR JOBBER SELLS THEM

Manufactured by

DART UNION
COMPANY, Limited
Toronto, Ont.

—the Pipe Coupling with the Bronze to Bronze Joint

"WORLD" UNIONS

NEW MODEL

No Leaks

Self-Aligning

Copper Non-Corrosive Seat

Ball Joint

Be sure you are right, then go ahead!

The "World" Union is right in design, material and workmanship. It is the Union that you will finally come to

Why Not Start Right?

T. McAVITY & SONS
LIMITED
Hardware and Metal Merchants
Brass and Iron Founders
ST. JOHN, N.B., CANADA
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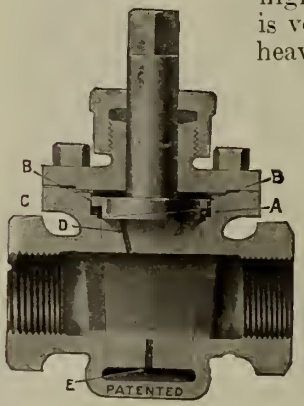
"Homestead" Quarter Turn Valves

Open and close easily. The patented balancing parts positively cannot stick.

When this valve is open the two surfaces which are depended upon for tightening are in no way affected by the material passing through. The plug cock provides a straight-way opening, which is desirable in all sorts of work, but is particularly important in high-pressure service. It is very useful when thick, heavy liquids are handled. With the "Homestead" valve you get *all the advantages of safety, economy and efficiency.*

AMONG USERS ARE THE LARGEST MILLS, MINES AND RAILROAD COMPANIES.

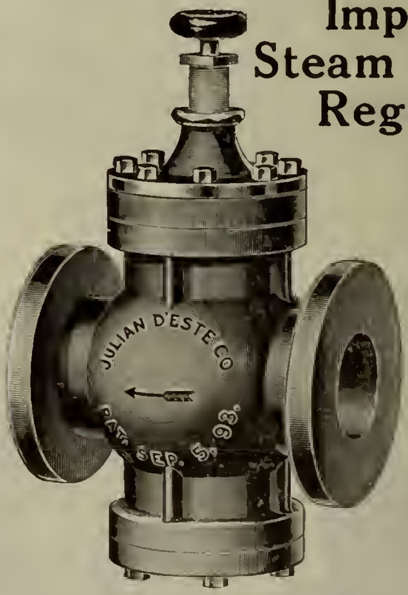
It will pay you to try them.



Homestead Valve Manufacturing Co.
PITTSBURGH, PA.
Works: Homestead, Pa.

CURTIS Engineering Specialties

Improved Steam Pressure Regulator



For Universal Application to all the varied and various conditions under which a reduced pressure of steam, water or other fluids is required, this Regulator (see illustration) has no equal. It is compact and self-contained, without levers, weights or projections.

No glands or packing; no drip or leak of steam or water. Suitable for any boiler pressure; made entirely of metal; is a lock valve, very simple and sensitive.

The universality of use of this Regulator is one of its best features, but it is in **Steam Heating** that its use is most common and obvious.

Send for leaflet fully descriptive of this Regulator (contains price list) to the manufacturers.

MANUFACTURED BY TH
JULIAN D'ESTE COMPANY
26 Canal St., Boston, Mass.

Money Saved—Work Made Easier

Considerable money can be saved and the engineer's work made much easier if the correct method of handling condensation in the boilers be adopted.

There are three things which are desirable in a device of handling the condensation.

1. It shall remove the condensation so efficiently that the boiler tubes shall be free for the live steam.
2. There should not be any stop-cocks to open, any engine to watch, any pump to keep oiled. It should be absolutely automatic so that the engineer shall be free to attend to other duties.
3. It should return the condensation to the boiler at as near the boiling point as possible, so that use is made of every available heat unit.

The "Detroit System" offer a positive method of removing the condensation from boilers and returning it at a temperature but a couple of degrees below the boiling point.

The "Detroit System" is absolutely automatic and it uses up no power in returning the water to the boilers—a big advantage over the pump and receiver method. Moreover, the water is returned directly to the boiler without giving it any time to cool.

The engineer who works for his employers' best interest will recommend the "Detroit System" as it saves many hundreds of dollars yearly in fuel.

Some one of the "Detroit Systems" will solve any problem in handling condensation ever encountered in actual business practice.

Write for full information on the "Detroit System" for handling condensation. It is found in Steam Trap Book No. 14-A.

CANADIAN *Sirocco* COMPANY
LIMITED

WINDSOR, ONTARIO.

(5)

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UNEQUALLED WORKMANSHIP
HIGHEST EFFICIENCY
COMPLETE SATISFACTION

ESCHER WYSS & CO.

WATER-WHEELS
GOVERNORS
TURBO-PUMPS
STEAM-TURBINES

WRITE FOR INFORMATION
AND PRICES

ESCHER WYSS & CO.
12 Coristine Bldg., Montreal

"See!
It isn't dusting"

"JUST as I told you—the right cement floor finisher would make our concrete floors wearproof, waterproof and oilproof. Now you see why I specified

R.I.W. REMEMBER ITS WATERPROOF **CEMENT FILLER & CEMENT FLOOR PAINT**
REG. U.S. PAT. OFF. PATENTED AS TO PORTLAND CEMENT FEB. 27, 1906

R. I. W. Cement Filler and Cement Floor Paint seal the sandy, porous surface of concrete and cement floors and in this way stop the constant sanding, water infiltration and the soaking up of oil.
And it is so easy to apply—anybody can do it perfectly.
Twelve standard decorative colors. A two-coat proposition that resists wear longer than anything else we have ever seen.
Don't let "cement dust" fly as the floor scuffs off or sands. Stop it immediately with an application of these wonderful preservatives, and save your machinery and stock. Write for illustrated Booklet from Dept. 59. *Manufactured in Canada by*

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TRADE MARK
RECORDERS

PROTECT the Owner, Manager, Superintendent, Foreman and Employee by reporting with unfailing accuracy every variation of important Pressures, Temperatures, or Speeds—Settle disputes—Leave no chance for an argument—Place the blame when things go wrong or helps to boost when things are well done.

Investigate why "Foxboro" Recorders will increase the efficiency of your Power Plant or Factory.

Our Engineering Department is at your Service.

Write for Bulletin No. BH-96.

THE FOXBORO COMPANY
Foxboro, Mass., U. S. A.
Or PEACOCK BROS.
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MADE IN AMERICA

If You Want Genuine Service Insist Upon the Genuine Jenkins' Discs

This means the acceptance of none other than those bearing the Diamond Trade Mark—the stamp of quality that protects you against imitation.

Jenkins' Discs stay tight under severe demands for very long periods. They have never been surpassed in durability.

Made in many different compositions to meet the needs of every class of service. Endorsed by leading operating men.

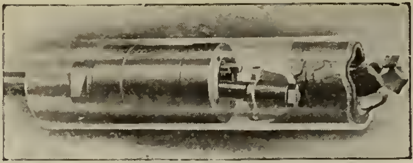
JENKINS BROS.' VALVES

They mean better and longer service because of their excellence in design, high-grade workmanship, the use of a special composition steam metal and Jenkins' Discs.

They are made in many styles, including globe, angle, cross, radiator, quick opening, whistle, check, Y or blow-off, hose and other patterns, either standard or extra heavy, screwed or flanged in sizes up to 3 inches. Your dealer can supply you.

Write us for the No. 8 Jenkins Bros.' Catalogue.

TRADE JENKINS MARK Jenkins Bros **Jenkins Bros. LIMITED** TRADE JENKINS MARK Jenkins Bros
103 ST. REMI ST. MONTREAL



The Dean removing scale from the tube of a water tube boiler.

Dean

You Can't Afford to Ignore SCALE—

YOU can afford to adopt no halfway methods in ridding your boilers of scale. Either your tube cleaner is removing **all** the scale—or it is not.

If even a small percentage of the scale is allowed to remain on the tubes, they will become greatly overheated, burn out in spots and put your entire plant in constant danger of a sudden explosion.

In competitive tests, the **Dean Boiler Tube Cleaner** has repeatedly demonstrated its superiority as a scale-remover against every mechanical cleaner made. In many cases, where other cleaners have been put to a severe strain to get off 100 lbs. of scale from a given number of tubes, the **Dean**, operated through the **same tubes** immediately thereafter has taken out an addition 100 lbs!

If you don't believe this, give us a chance to prove it to YOU!

You may be **absolutely positive** that you have no scale, or that your present cleaner is satisfactory. So were many of our good friends before they tried the **Dean**—

BUT, when it's made so easy for you to experiment with the **Dean**, and **make sure**—

It's worth the slight effort of trying it out, isn't it?

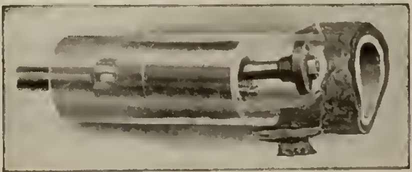
Write for booklet 130 and details of Free Trial Offer.

The William B. Pierce Co.

153 Ellicott St., Buffalo, N.Y.

201-2 Coristine Bldg., Montreal, Quebec

Winnipeg Representative: W. W. Hicks, 567 Banning St.



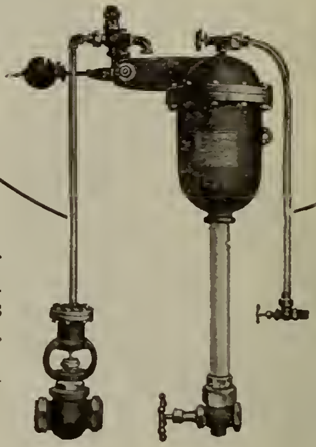
The Dean removing scale from the tube of a return tubular boiler.

ON GUARD!

—The **Vigilant** will safeguard your boiler room from dangers of high and low water accidents.

—And it really costs you nothing for this assurance of safety, because the **Vigilant** effects a saving in coal of 3 to 17%.

—It is the best and cheapest form of liability insurance obtainable.



You'll like our booklet and Engineer's data cards.

Send for them TO-DAY.

The Chaplin-Fulton Mfg Co.,
28 Penn Ave.
Pittsburgh, Pa.

Mechanical Regulation of Boiler Feed Water

By the use of the "S-C" method you are assured of a continuous feed at all times load is on boiler. The graduation in rate of feeding is entirely dependent upon the load and fire conditions. The Regulator will carry a constant level on steady load—higher level on light load and lower level on peak loads. Variation in water level is entirely dependent on inclined position of generator which is adjustable while operating under full load.

Bulletin No. 21 explains all.

Generator or Actuating end of Regulator.

Regulating Valve Placed at Any Point, Any Position.

The "S-C" Regulator Company
FOSTORIA, OHIO, U.S.A.

Murphy AUTOMATIC Furnace

Murphy Automatic Smokeless Furnaces

Canadian Repeat Orders Since January 1st, 1916

The Laurentide Co., Ltd.,	Grand Mere, P.Q.
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and Thirty-three Repeat Orders from American Users—one of which was **18th contract**; the 18 contracts cover **136 MURPHY FURNACES**

Write to-day for Catalogue

MURPHY IRON WORKS, BUFFALO, N. Y.
DETROIT, MICH.

Goes Right on Your Present Valve Wheel

"Goes on" is about right, too, it's so easy to apply, and by putting a

Babbitt Adjustable Sprocket Rim

on each of those hard-to-get at overhead valves you can save a lot of time you now spend in hunting ladders and all the risk you now run in using them after you've found them. One concern that thought two would do, bought 27 in a little over two months. The price will encourage you to have enough of them.

Ask your dealer. Write for Illustrated Folder.

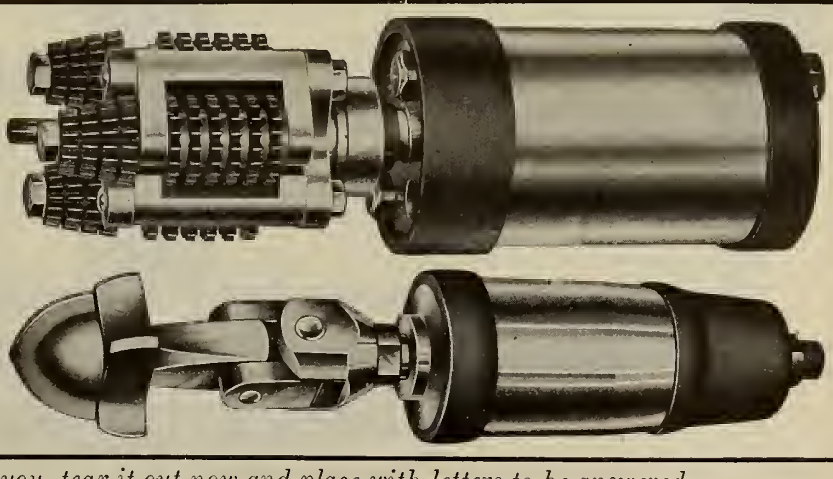
Babbitt Steam Specialty Co., 59 So. Water Street, **New Bedford, Mass.**
The R. E. Cleaton Co., 20 St. Nicholas St., Montreal, Que.

ROTO TUBE CLEANERS

Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.
The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.

THE ROTO COMPANY
Write for Catalog HARTFORD, CONN.



Sliptivity SteamCylinder

Sliptivity Steam Engine

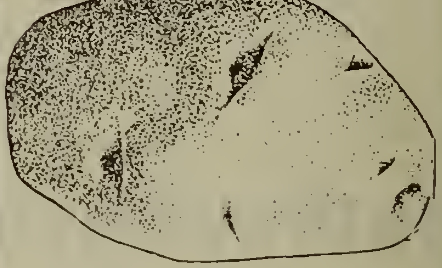
Automobil Cylinder

OILS

These Lubricants give remarkable service. They will keep your machinery running smoothly, easily and with a minimum of wear and cost.

No better time than now to put them to the test. The prices are very reasonable.

Potato Scale Powder Boiler Cleanser



Will positively rid your boilers of old scale and will *keep* tubes clean if but a small amount is fed daily through the feed water.

Eliminates foaming, pitting or any other boiler troubles due to impurities in the water supply. *Makes big reduction in fuel bills.*

Sold UNDER A POSITIVE GUARANTEE. Try a Barrel.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania. Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants. Polish, Waste, Oil Tanks, etc.

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Good things for the POWER PLANT

THE BELT WITH A GRIP

"Lincona"

BALATA BELTING

will pick up a load suddenly better than any other type of belting

BECAUSE

it has a GRIP that no other belting has and requires no dressing.

"Lincona" will give you the maximum transmission of power

"Lincona" is the strongest Balata Belt Made.

The tensile strength of "Lincona" is almost double that of leather belting and there is less stretch and straighter running than any other type of belting.

The secret of the greater strength of "Lincona" Balata Belting is in making the Balata a fluid which will saturate the duck, instead of a paste placed on and rolled in. The fluid Balata used in the "LINCONA" process also allows the duck to be compressed more closely, so producing a Belt thinner for the number of plies. This gives a stronger wearing surface to the pulley and less friction.

"Lincona" Balata Belting can be exposed to snow, rain and every condition of weather without injury. It can be run in water without trouble. Write us about your specific needs.

Manufactured by

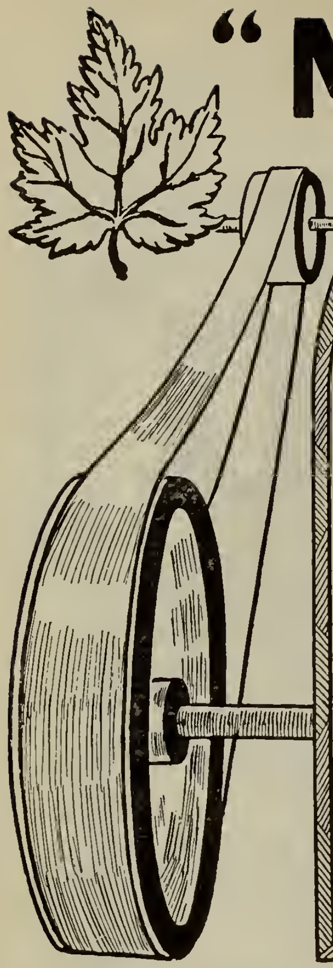
JAMES DAWSON & SONS, LIMITED, - LINCOLN, ENGLAND

The Canadian B. K. Morton Company, Limited

49 Common Street, Montreal **86 Richmond St. East, Toronto**

Austen Bros., Limited, Halifax, N. S. Sherwood & Fraser, Limited, Winnipeg, Man.
Western Oil & Supply Co., Vancouver, B.C.

"MAPLE LEAF"



Stitched Cotton Duck

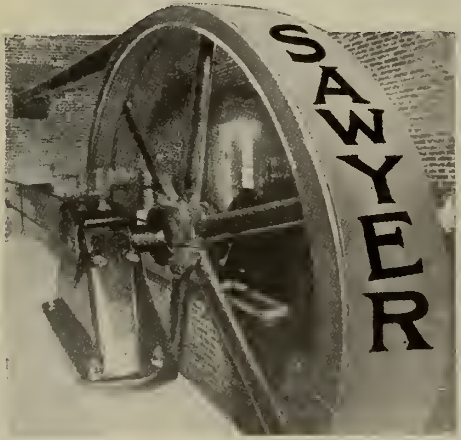
Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.
A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada



SEE THE NAME?

THAT'S SAWYER STITCHED CANVAS BELTING

Quality Stands Out Like The Name After Twenty Eight Years of Hard Work

Look For The Name
And Be Sure

TRADE **SAWYER** MARK
Registered

E. B. PLEWES CO., DISTRIBUTORS.
"A good concern to do business with"
120 LOMBARD ST. WINNIPEG

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to 1½ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.

MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless

Any Quantity sent on APPROVAL

Appearances Are Deceiving

Not always, but quite often **appearances are deceiving.**

Make it safety first and buy the belting that has a splendid record of service.

Many of the largest power plants in Canada are users of

D. K. McLaren's Genuine British—Oak-Tanned Leather Belting

This means merit, for these big places want the best of everything.

Now, don't you think it would be a good idea to ask us for the names of some of our customers, and then write these firms for their honest opinion of the worth of our product?

D. K. McLaren's Leather Belting

is the result of selection of hides by experts, and our Genuine British Oak Method of Tanning—a slow process which makes leather exceedingly tough, durable and flexible.

It doesn't require the attention and expense that is common where ordinary belting is used, and its grip means efficient delivery of power.

Take a postcard now and write us for list of names.

TORONTO, ONT.
194 King St. West

ST. JOHN, N. B.
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D·K·McLAREN
LIMITED

VANCOUVER, B. C.
847 Beatty St.

ENGINEERS SUPPLY CO.,
123 Bannatyne Ave. East,
Winnipeg, Man.

HEAD OFFICE AND FACTORY: 351 ST. JAMES ST., MONTREAL, P. Q.

"FIVE LINKS"

in the Chain Which Joins a Modern Steam Plant with Highest Efficiency.

"Link" No. 1— Garlock Style No. 200 is unsurpassed for use on rods working against high pressure and superheated steam, for expansion joints and rods running in oil, grease and acids.

"Link" No. 2— Garlock Style No. 5 will give excellent service for low pressure steam and hot water.

"Link" No. 3— Garlock Style No. 285, when used with Style No. 286, which is cut sectional, will give excellent service on ammonia rods.

"Link" No. 4— Garlock Style No. 333 is unequaled for medium pressure steam, hot water, etc.

"Link" No. 5— Garlock Style No. 336 is adapted to rods not running true or that are badly scored.

Write for our new catalog.

The Garlock Packing Co.

Hamilton - Ontario

Branches in Principal Cities

Aside from the *service* they give—you can get them so *quickly.*

We have always made it a point to render a two-fold service with American Pulleys—first, a country-wide dealer distribution that always makes it easy to get any standard American Steel Split Pulley you want; and secondly, a pulley so good that it will give greater dollar for dollar value than any other pulley on the market.

The 20-year service record of American Pulleys is proof of the pulley service they give—an organization of over 200 dealers located at strategic points throughout the United States and Canada and backed up by 5 warehouses of our own, containing over 60,000 pulleys. This is the service we render pulley buyers in order to give them quick deliveries at any time.

American Pulley Co.

4234-60 Wissahickon Ave. - - Philadelphia, U.S.A.

New York, 33-35 Greene Street; Boston, 165 Pearl Street;
Chicago, 114-116 S. Clinton Street; Seattle, 526 First Ave., South.
Williams & Wilson, Limited, Montreal; The A. R. Williams Machinery Co., Limited, St. John, N.B., Toronto, Winnipeg, Vancouver.

AMERICAN STEEL SPLIT PULLEY

Over 60,000 pulleys—3 in. to 120 ins. in diameter—stocked at centers named above, and additional thousands stocked by over 200 dealers insure prompt deliveries. Write for quotations and delivery dates.

A Good Test for Cling-Surface Treatment

Fans are often run at high speeds and located where heat, settling dust and short centres combine to make trouble for the belts, but **not** where Cling-Surface is used.

The three belts shown are all in the same plant, all drive high capacity fans, all are treated with Cling-Surface and all are run slack without slip.

Imagine the power saved, the protection against overheating of bearings, and the preservation of the belts themselves secured through absence of initial belt tension, as proven by the following data:

Belt No. 1 (foreground upper picture), 8-ft. fan driven by 7½ h.p. motor with 8-in. 800 r.p.m. pulley. Driven pulley 21 in. Centres 7 ft. 6 in. apart. Belt is 5-in. 2-ply leather and runs with 13-in. sag.

Belt No. 2 (background, upper picture), 10 ft. fan driven by 25 h.p. motor with 12-in. 750 r.p.m. pulley. Driven pulley, 34 in. Centers, 7 ft. 6 in. apart. Belt is 6 in. 2-ply leather, and after only two months of Cling-Surface treatments, ran perfectly with 16 inches of slack.

Belt No. 3 (lower picture), 8-ft. fan driven by 7½ h.p. motor with 5-in. 1050 r.p.m. pulley. Driven pulley, 24 in. Centres, 6 ft. apart. Belt is 5 in. 1-ply leather and runs with 17 in. sag.

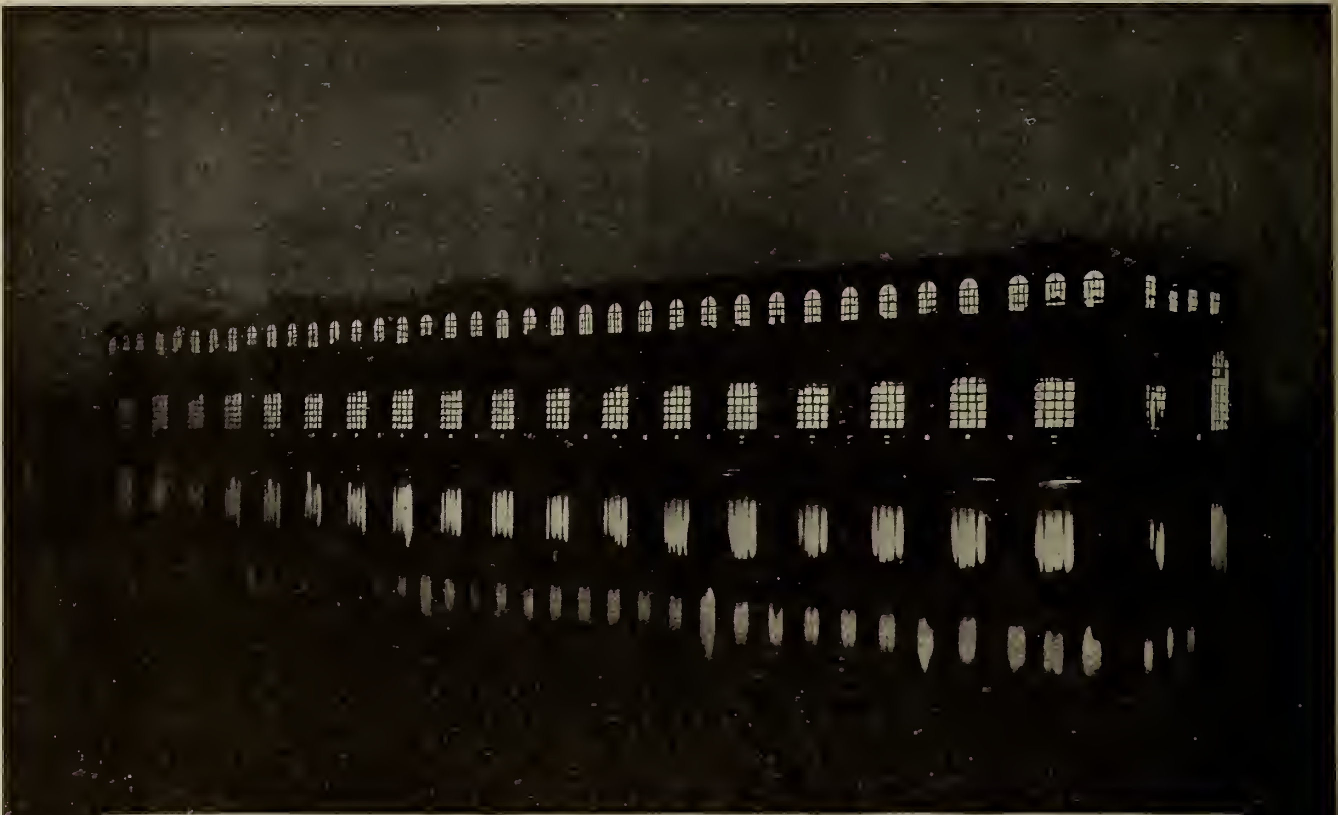
Besides, these belts are all pliable, waterproof, and never run off or give trouble of any kind. They do their work at least annual expense, give no trouble and will long outlive any untreated belts.

The new semi-liquid form of Cling-Surface makes application very easy, and the expense of treatment is insignificant. Do yourself and us the justice of a trial or at least send for literature. We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

Cling-Surface Co

1057 Niagara Street
Buffalo NY



The Power House of Keokuk, on the Mississippi River, by Night.

The World's most important power plants employ

Silent Chains (MORSE, of Course)

Eleven 23 H.P. Oil Pump Drives (as illustrated below) are located in the Keokuk Power House. Seventy-two 24 H.P. drives are employed at Panama for operating the safety gate hoists. The largest chain drive in the world (5000 H.P.) drives a generator in a western power plant.

Your plant, no matter how large or small, can employ silent chain drives somewhere to good advantage—for driving pumps, governors, fans, blowers, exciters, compressors, etc., and, because of the exclusive "Rocker-Joint" construction, assuring longest chain life and greatest economy, we ask that the *make* of chain chosen be "MORSE," Of Course.

Morse Chain Co., Ithaca, N.Y.

Please send copies of your Latest Publications to the address given below. Also name preliminary proposition for a MORSE Silent Chain Drive as per the following specifications:

Maximum H.P. to be transmitted ....

Drive from .... to ....

R.P.M. of driver .... Of driven ....

Distance between shaft centres ....inches

Daily use desired of about ....hours

Name of individual ....

Company ....

Address ....

S-14, Power House, 9-23-16

"This is the man for the job"

In these days the big jobs are for the engineers who know. In many states, this means *licensed* engineers. It has always been our policy to do what we can to help engineers "move up." That is why we offer, *free*, a License Examination Book. (See coupon below).

DANIEL'S ROD PACKING

P.P.P.

FOR STEAM, AIR, WATER, AMMONIA

Reg. U S. Pat. Off.

While some engineers may not realize it, it is a fact, nevertheless, that the "old man"—striving to keep down manufacturing cost in order to meet competition—is carefully watching the operating cost and upkeep expense of his power plant.

So far as rod packings affect operating and upkeep costs we have made scientific study of the question. Too, we can prove by the experience of users and an exhaustive series of tests that P. P. P. is saving tens of thousands of dollars, annually, on coal bills. In some cases P. P. P. cuts $500, yearly, off the cost of running a single engine.

Write for the free book, and let us tell you how to save the "boss" money and yourself trouble.

License Examination Book, Free

Fill out and mail this coupon. We will send you our Blue Book of Questions and Answers to Engineers' License Examinations absolutely FREE.

Your name ....

Address ....

Capacity of Ice Machine ....

Employed by ....

Address ....

Horsepower of Engine ....

Brand of Rod Packing Used....................................

QUAKER CITY RUBBER COMPANY

MANUFACTURERS OF MECHANICAL RUBBER GOODS

PHILADELPHIA, PA., U.S.A.

FOR PLANERS

WORCESTER LUMBER CO., CHASSELL, MICH.

Magnolia Metal Co., March 23rd, 1916.

Gentlemen:

In my twenty-five years' experience in saw, shingle and planing mills I have used all the principal brands of babbitt metals. After a great many severe tests. I find Magnolia Metal to be superior to all others for all general purposes.

I babbitted the cylinders of one of our planers eight years ago, and the machine has run on an average of more than ten hours per day since, at a speed of 4,000 R.P.M., and will probably run another year or more without rebabbitting.

Yours very truly,
FRED. GRAY.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c. post paid.

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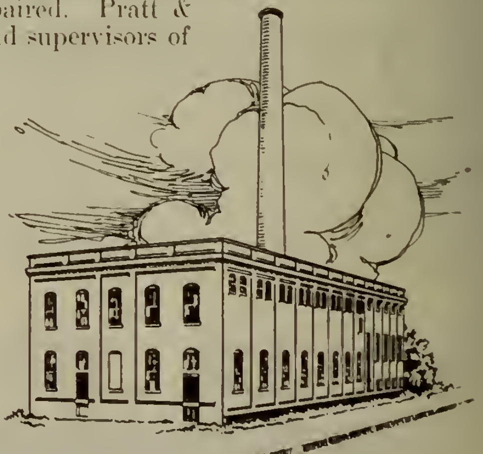

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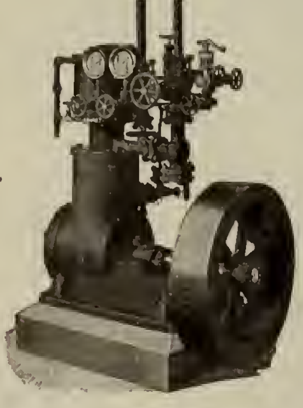

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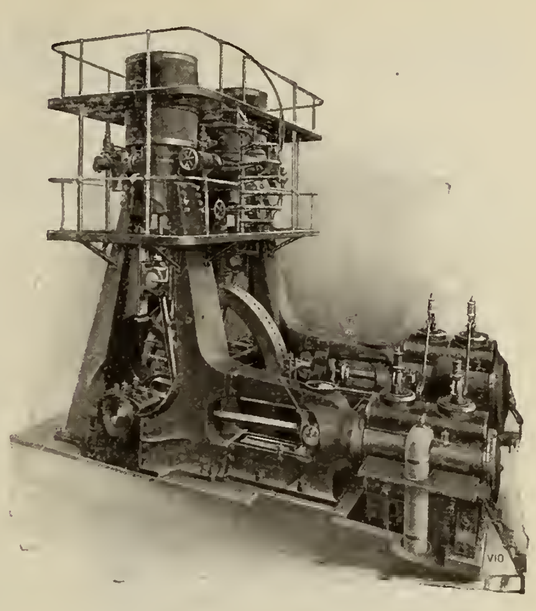

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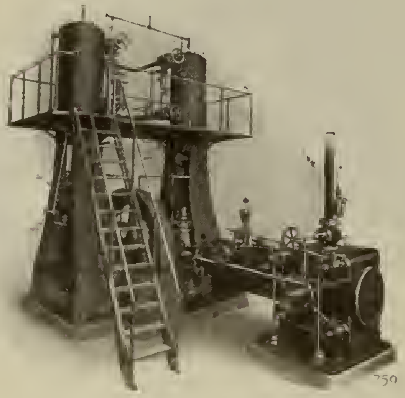

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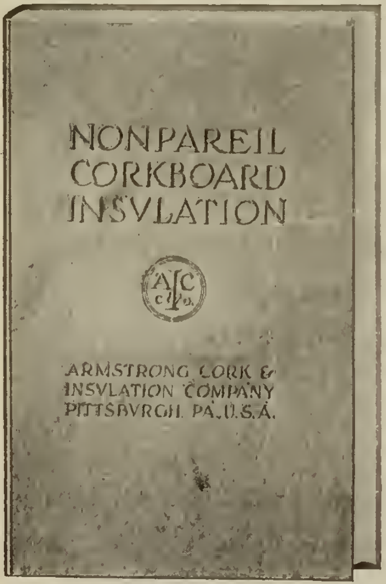

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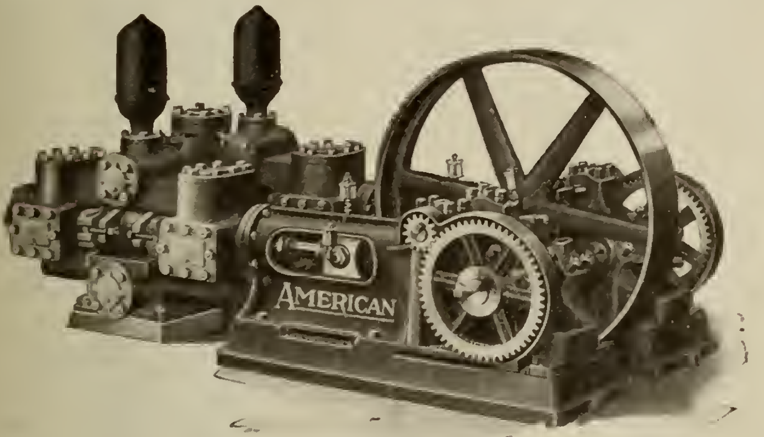

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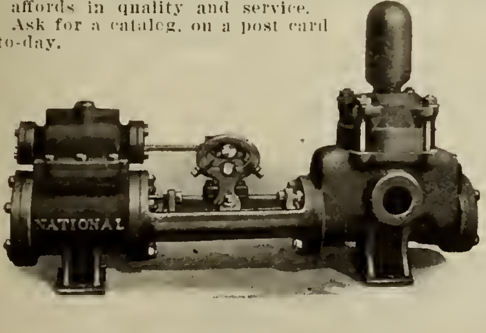

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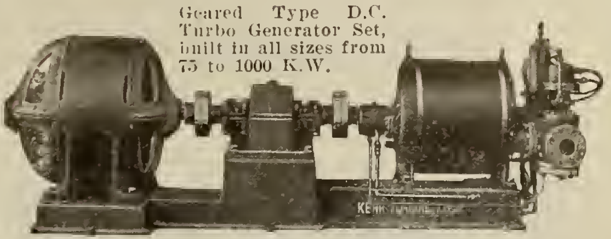

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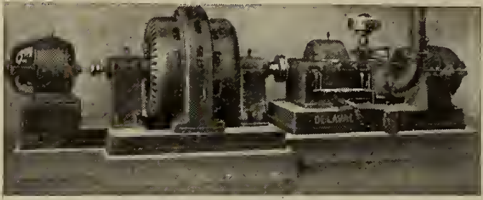
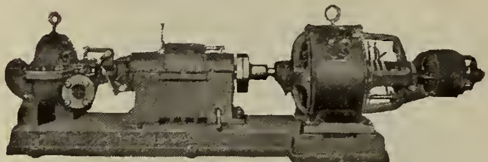
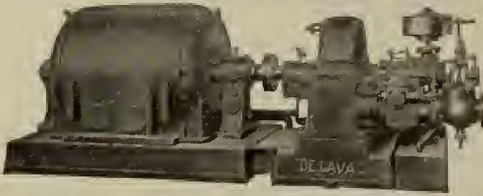


De Laval geared mixed-flow, velocity-stage turbine driving 200 kw. alternator at 750 r.p.m.



De Laval geared turbine driving 20 kva. alternator; type of unit used in small isolated plants, or during night and light load periods in larger plants, or for supplying current for driving auxiliaries.



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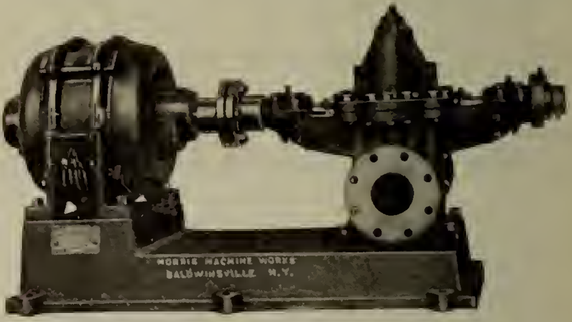

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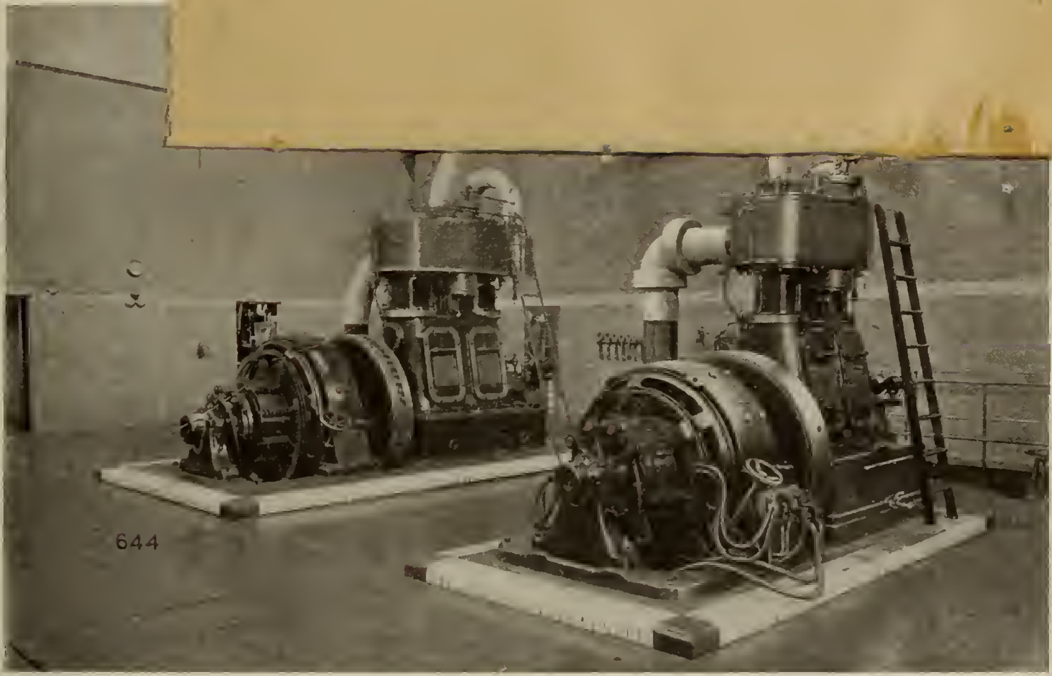

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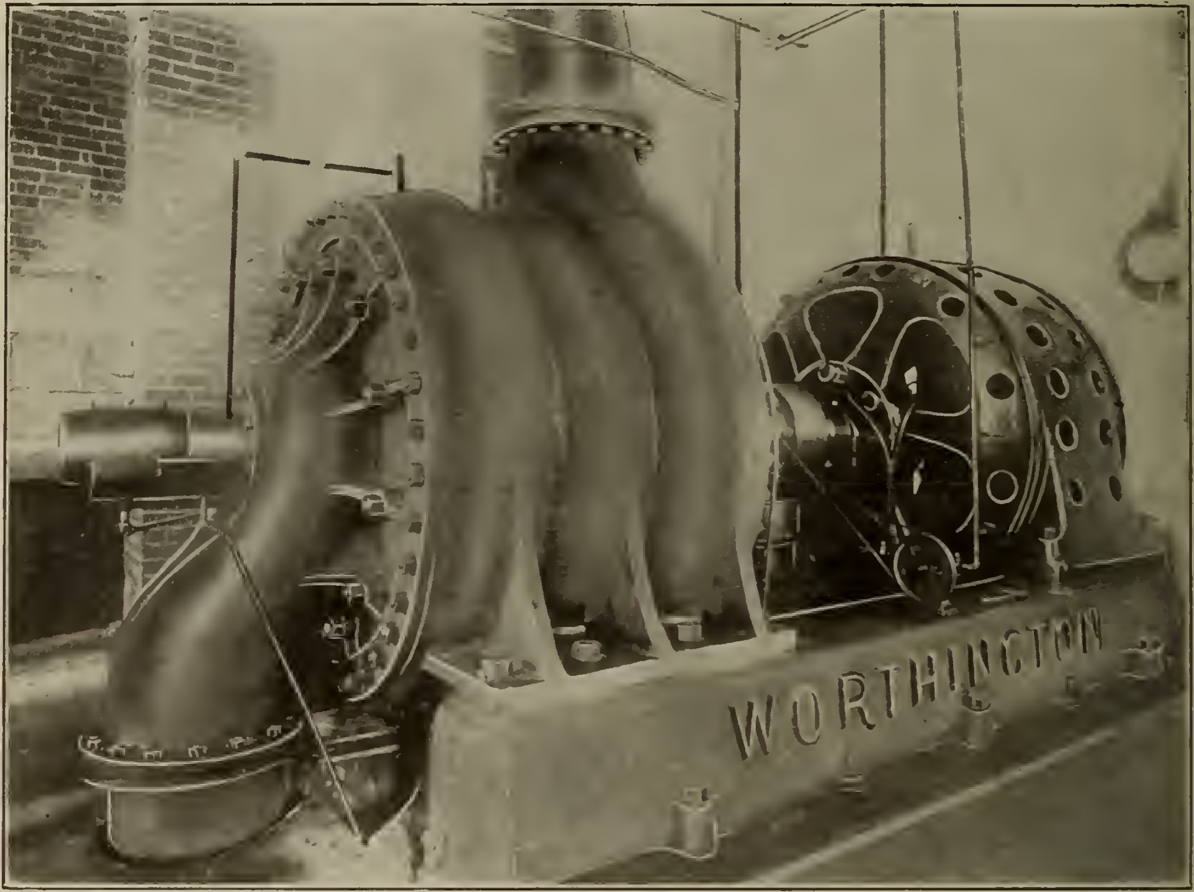

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The Publisher's Page

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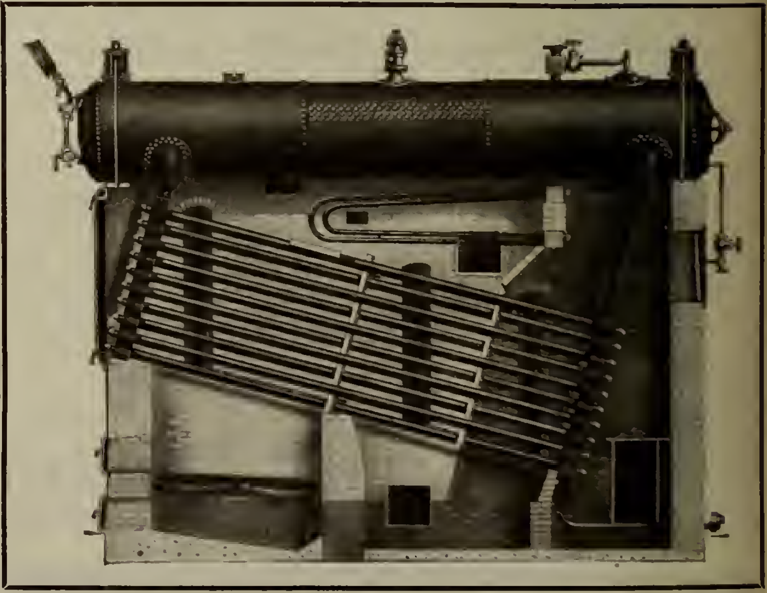

Steam Power Plant, Boiler House Design, and Operation *

By W. W. Lackie **

Although for many years both apparently and in reality a secondary consideration, the boiler house in its triple features of design, equipment installation, and operation, has at length assumed its rightful place in the estimation of steam users, however limited or extensive the individual activity scope of the latter. The accompanying article, in addition to the embodiment of a resumé of past endeavor, demonstrates not only present-day advancement, but points the way to still greater and more highly specialized achievement in the future.

THE design, equipment and operation of a boiler-house in connection with an electricity generating station invite attention to a variety of quite distinct engineering problems, almost any one of which would require a paper to itself. Many considerations have to be kept in view in the design of a modern boiler-house, but the main object has come to be to have the maximum of steaming capacity in the minimum of space. The necessity for this has largely been brought about by the introduction of turbine-driven generators and the ever-increasing size of generating sets. Twenty years ago, in the design of a generating station, it was a simple matter to install an additional boiler for each addition to the engine-room plant, as a reciprocating engine of 500 horse-power, or even 1,000 horse-power, with its generator occupied practically the same amount of space as the boiler plant required to supply steam to such sets.

Engine and Boiler Room Areas

In these early stations the area occupied by the boiler-house was practically the same as the area necessary for the engine-room, and extensions were easily made. On account of the poor load factor which prevailed in these stations, due to the fact that the demand was mainly for lighting supplies, the limited area of supply, and the central site chosen for the station, economizers were seldom installed and the stations were run non-condensing. The power per square foot in the engine-room varied, but 1 horse-power per square foot of engine-room floor space was an average figure. The boiler-house was, as a rule, a one-storey building, and an evaporation of 14 lbs. of steam per square foot of boiler-house floor space, or 42 lbs. per square foot of boiler floor space, was the steaming capacity. This was considered a good average figure. The boilers were hand-fired and the coal store was the floor in front of the boiler or a bunker in front of and practically on the same level as the boiler. All ashes had to be removed by hand on to the boiler-house floor or direct into hand-barrows, to be wheeled away at any convenient time.

A few years later, when it began to be recognized that the supply of electrical energy for power purposes was an economic possibility and larger stations were being erected, the power per square foot of engine-room space per horse-power was not seriously increased, as condensing engines were installed, and the space required for condensers increased the size of the engine-room and increased the total space occupied by the steam-using plant. Larger boilers were used, but economisers were then installed, and these were, as a rule, on the boiler-house floor level, and the evaporation per square foot of boiler-house space was not seriously increased.

The further growth in the demand for electric energy, the much improved load factor, and the introduction of the use of the steam turbine for the driving of electric generators about the year 1904, brought about a distinct change in the relative space required for engine-room plant and boiler-house plant. The turbine-room came to consist of a two-storey building, the condensers being on the ground floor or basement floor, and the turbo-generators on a floor above. Instead of having 1 horse-power per square foot of engine-room floor space, we have to-day turbine-rooms with 5 horse-power per square foot, and in designs for new power stations, using 15,000 to 30,000 kw. sets, this figure may go up to 20 horse-power per square foot of engine or turbine-room floor space.

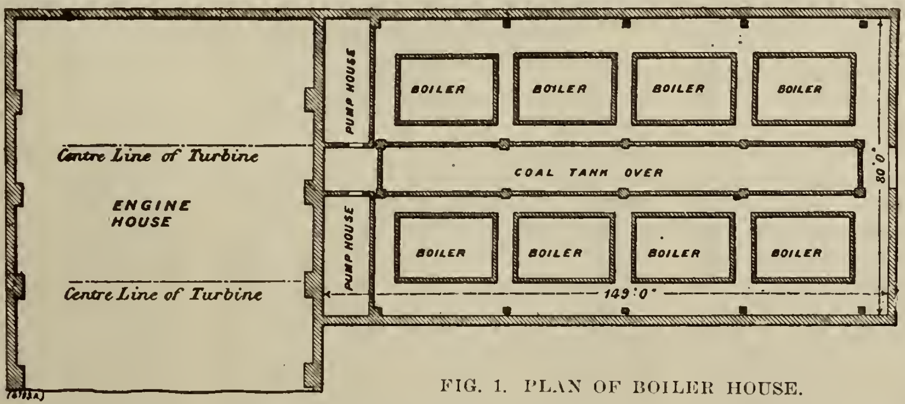

FIG. 1. PLAN OF BOILER HOUSE.

Advent of Turbine-driven Generators

With this enormous increase of power per square foot of turbine-room, changes in boiler-house design are absolutely imperative, particularly in the lay-out of the boilers, otherwise the space occupied by the boiler-house will be out of all proportion to the space allotted to the turbine-room. It is now recognized that even with improvements in boiler-house design, where very large turbo-generators are in use, every pair of such sets require a separate boiler-house. Several present-day power-houses have an evaporation of 50 lbs. of water from and at 212 deg. F. per square foot of ground space occupied by the boilers, but it is possible with improved design of the boiler-house plant to approach an evaporation of 100 lbs. from and at 212 deg. F. per square foot of the ground space actually occupied by the boilers. We therefore find that while the engine-room floor space and the boiler-house floor space were 20 years ago about equal, and remained so even for 10 years thereafter, to-day in a large modern generating station the ground space occupied by the boiler-house is from 1½ to 2½ times the space occupied by the turbine-room.

The Modern Boiler House

The first consideration is to ensure the maximum grate area per square foot of boiler-house floor space, and it appears that burning coal with natural or induced draught at from 25 to 30 lbs. per square foot of grate area there is a limit to the maximum possible continuous output per square foot of grate area, and that consequently there is a limit to the maximum power per square foot of boiler-house floor space. Arranging the boilers and economizers all on one floor practically doubles the area of the boiler-house; and in a modern boiler-house anything that adds to the area is to be avoided wherever possible. It is in fact now recognized that a modern boiler-house should consist of three storeys at least; the basement or ground floor containing ash-handling plant, the second floor containing the boilers proper, and the third or upper floor containing economisers and coal-conveying machinery and probably coal storage in the form of overhead hoppers above the boilers. Draught fans may be placed on any one of the three floors.

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*Paper read before the Incorporated Municipal Electrical Association (British), on June 22, 1916.

**Engineer and Manager, Glasgow Corporation Electricity Department.

Chimneys and Draft

The question of chimneys and chimney draughts is by no means settleed, but, in stations where boilers of 50,000 lbs. capacity are installed, it is necessary to erect a separate chimney for each boiler or each pair of boilers. One is practically compelled to adopt steel in preference to brick for chimneys in a modern boiler-house, as with steel the chimney can be erected from the third floor, on which the economisers are placed, whereas if brick is used foundations have to be laid on the basement or ground floor and the structure continued to the third floors, at which point only it comes into useful commission. The brick chimney foundations and superstructure up to the second floor simply mean a waste of valuable space and a mass of brickwork which serves no useful purpose. It is desirable not only to deal with ashes ejected from the boilers, but also to deal with riddlings and any semi-burned fuel. These riddlings have to be returned to the coal-conveying plant and thence to the overhead coal-hoppers, so as to be used again in the furnace.

Water Tube Boiler Indispensable

The necessity for concentration of power has made the water-tube boiler indispensable for the modern power-house. The evaporative capacity of any boiler depends upon the grate area, or, in other words, the quantity of coal which can be burned underneath it, and consequently the maximum concentration of power is obtained when the whole of the generating and recuperating surface is assembled directly over the grate. Even with this type of plant the assembling of the heating surface over the grate area is undergoing modifications in order that the highest possible evaporation per square foot of ground space may be obtained. The space actually occupied by boilers at present, with the necessary passages between, does not as a rule exceed 33 per cent. of the total boiler-house floor space, and of this 33 per cent. the grate area only accounts for one-half.

Let us consider the case of a boiler-house which has to supply steam to two 15,000 kw. sets. The steam required for each set will amount to between 180,000 and 200,000 lbs. of superheated steam per hour. This steam under modern conditions would be supplied by four boilers, each capable of generating 50,000 lbs. of steam. Each boiler will require to burn at least 7,000 lbs. of coal per hour, depending upon the calorific value of the coal. This means that grates of 250 to 270 sq. ft. will be necessary. A grate area of 250 sq ft. means that each boiler will actually occupy, with passages between, about 500 sq. ft. eight boilers will require 4,000 sq. ft., and the boiler-house will have a floor area of 12,000 sq. ft. Fig. 1 shows a plan of such a boiler-house, Fig. 2 is a cross-section, and Fig. 3 a longitudinal section.

From what has been said it is clear that increasing the size of the boiler unit will not of itself seriously increase the power per square foot of floor space. Twenty years ago water-tube boilers of 4,000 to 6,000 sq. ft. heating surface were considered large. To-day boilers are made with a heating surface from 10,000 to 20,000 sq. ft. In Detroit five boilers each with over 20,000 sq. ft. heating surface are in use. The plan of installing boilers (apart from economisers) on two floors ought only to be adopted where the exigencies of the site render such an arrangement inevitable; that is to say, where land is dear or where local building regulations limit the dimensions of buildings in certain areas. In the new station of the United Electric Light & Power Co., at 201st Street, New York (notwitstanding that this district is a suburb of New York) the company have been forced to adopt the flatted arrangement for their boiler-house in order to comply with city requirements.

Daylight in Boiler Rooms

The boiler-house must no longer be a stokehold with an atmosphere of grime and dust and dirt. It should be designed to admit of an ample supply of natural daylight. This is managed by placing the boilers back to back instead of face to face, with a firing floor down each side instead of down the middle between the two rows of boilers. Light can then be had from windows in the side walls as well as from the roof. This, however, means a larger floor area and a space between parallel boiler-houses, and further increases the ground ar occupied by the power-station. Such an arrangement is shown in plan on Fig. 4 and in section on Fig. 5. Adequate daylight can be got from roof lights with proper design of the roof and Figs. 1, 2 and 3 show such an arrangement.

Combustion Chamber Feature

There is still a tendency to-day to construct the combustion chamber of boilers much too small. A combustion chamber should be of such dimensions as to allow ample space for complete combustion taking place and the products of combustion thoroughly mixing before coming on to the heating surface. The author finds that the older boilers had 2 to 2½ cub. ft. of combustion chamber per square foot of grate area. To-day similar boilers have 5 cub. ft. of combustion chamber per square foot of grate area. The Detroit boilers before referred to have 9 cub. ft. per square foot of grate area, and it is geneally conceded that this fact is very largely responsible for the high efficiency of these boilers at widely varying loads.

Boiler Fittings and Accessories

It is not necessary to enter into the details of the usual fittings of boilers, such as safety valves, high and low water alarums, dial steam-pressure gauges and miscellaneous valves; but it may be said that the equipment of a modern boiler includes two draught-gauges. One of these should show the differencee in pressure between the combustion chamber and the outlet from the boiler, i.e., the difference in pressure across the boiler elements. This will be a measure of the flow of the gases through the boiler and will indicate when a boiler requires cleaning. The second draught-gauge should show the difference of pressure between the ash pit and the outlet of the boiler. This second gauge will always read higher than the first, and the difference is obviously a measure of the draught through the fire. Steam-flow meters are as necessary on boilers as an ammeter is on a generator, as they indicate what each boiler is doing, and whether all the boilers are doing their fair proportion of the work. One or more CO_2 recorders have been for some years installed as part of boiler-house equipment, and these are found to be a valuable adjunct, as they are an index of the working efficiency of the boiler-house. A word of warning, however, is required against assuming that high CO_2 always means high efficiency. There may be a large quantity of CO present. There should be thermometers or pyrometers with dial face on every boiler, giving the temperature of the superheated steam leaving the boiler, also the temperature of the gases at the damper.

Steam Piping.

With boilers of the size under discussion, steam piping should be carried from each boiler or pair of boilers to a steam drum or receiver placed on the boiler-house floor or basement floor adjacent to the wall between the boiler-house and the turbine-room. This arrangement is preferable to one large steam header. From the steam receiver a steam pipe is led to a turbine and another pipe to the next receiver, so as to give interchange of steam from one set of boilers to another when required.

We may at an early date see an increase in the boiler pressure from 160 and 200 lb. to 250 lb. The Commonwealth Edison Co. of Chicago worked the boilers in their Fiske Street Station, at 200 lb. until 1907, when they adopted 225 lb. at their Quarry Street Station, and in 1910 they adopted 250 lb. at their North-West Station.

Fuel-Handling and Storage.

A station of 50,000 kw. capacity and burning 200,000 tons of coal per annum requires coal-handling facilities for a supply of 1,000 tons of coal per day, together with facilities for the handling of ashes to the extent of 100 tons per day. This means a railway siding capable of holding from 100 to 120 full trucks, and probably another siding of equal dimensions to hold the empty trucks. The provision of an adequate railway siding is therefore a costly adjunct in the lay-out of a large power house owing to the serious addition to the site which it entails. The length of railway sidings for a 50,000 kw. station would not be less than half a mile, or an addition to the site equivalent to 4,400 sq. yards. The wagons have to be tipped and coal-conveying plant has to be provided capable of handling 100 tons per hour. Coal-breaking machinery should be installed, for while we have in the past been in the habit of using small coal, circumstances may in the near future render it economical to buy and break larger coal. This question, however, brings in the whole question of mechanical stokers, and that subject would require a paper to itself.

Large coal storage accommodation is advisable and will prove economical. Not less than from two to four months' fuel supply should be retained. This marginal stock enables coal to be delivered in fairly regular quantities throughout the year and may result in lowering coal prices. The height or depth at which coal can be stored depends upon the class of coal, and the best method of storing coal is still undecided. The cost of lifting coal from canal barges or from trucks, and placit overhead in coal hoppers or in the coal store, is a small item in the total price of coal.

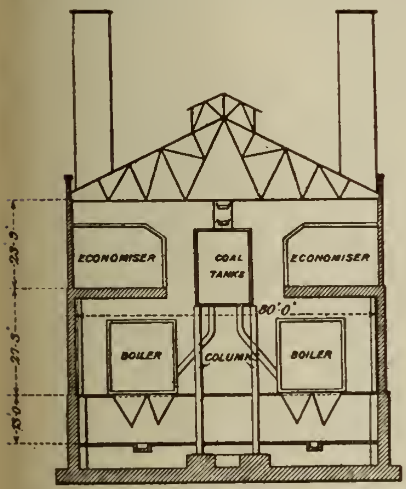

FIG. 2. CROSS SECTION OF BOILER HOUSE.

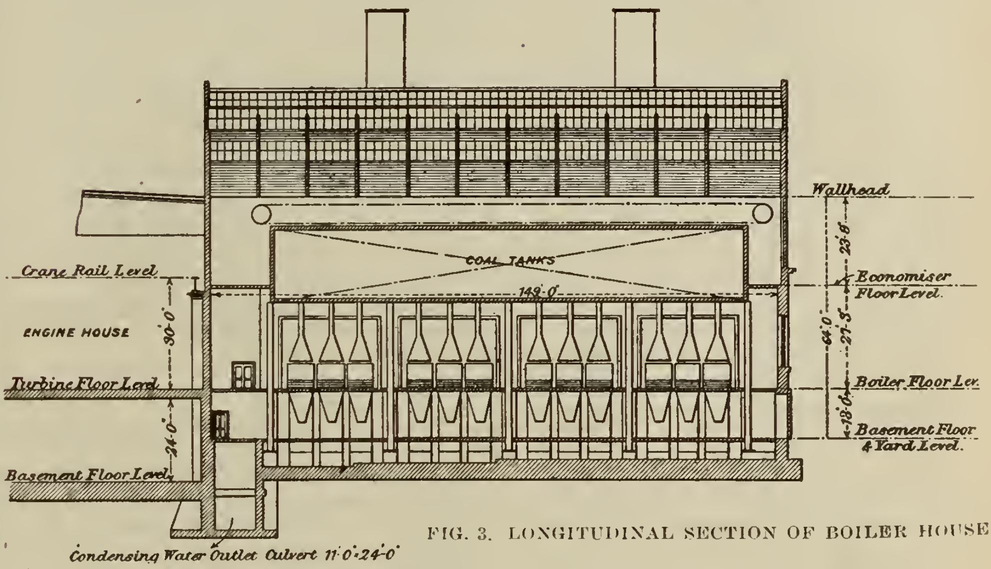

FIG. 3. LONGITUDINAL SECTION OF BOILER HOUSE.

Coal Transporters

In one Glasgow station we have a coal transporter fitted with a 1-ton grab. This transporter cost $13,000, and it handles coal at the rate of 40 tons per hour, and the cost of energy, labour and repairs on it brings the cost of handling coal in this way to just under 2 cents per ton. In another station truck-loads of coal are elevated 30 ft. at one end of the coal store to an overhead platform, whence the coal is tipped into an overhead hopper or to the coal store, and the empty trucks lowered by a second elevator at the other end of the coal store. These two elevators, complete with electrically-operated capstans, cost $10,000. The inclusive cost of handling coal in this way is 6½ cents per ton, the higher cost being due to the amount of labour necessary for handling the trucks. These figures are conclusively in favour of the grab and transporter. Where coal has to be carried a short distance from coal store to boiler-house, bucket or tray conveyors appear to be the right thing. On the other hand, for longer distances, the telpherage system works out slightly cheaper, although the human element, with its attendant problems, enters more largely into the telpherage system.

Ash Removal

For the removal of ashes, bucket conveyors have proved to be costly in upkeep on account of the wear of the axles and pulleys, caused by the fine, hard grit os ash dust;,but even with that drawback, bucket or tray conveyors seem to be the cheapest method of removing ashes. Suction ash plant is finding much favour on account of the absence of moving parts in its design, but the capital cost is very much greater (about three times) than that of bucket conveyors. Suction plants have not yet been long enough in use to warrant any definite pronouncement being made as to the repair bill.

The cost for operating suction ash plant works out at about 10 cents per ton handled, with energy at 2 cents per B.O.T. unit. Suction plant is now made to do other work. It can be constructed for the purpose of elevating riddlings and small unburned fuel to a hopper or tank over the coal-conveying plant. It can also be made suitable for the removal of soot from economiser soot chambers and flue dust from the base of the chimneys. The efficiency of the ordinary vacuum cleaner is well known, and it appears that suction plant should be quite successful for the handling of this lighter material. The atmosphere in which all these operations are carried on is greatly improved by the action of the vacuum plant.

A modern boiler-house calls for comparatively large overhead ash storage, from which ashes can be dropped into wagons or other vehicles for their removal to a coup. The removal and disposal of ashes is becoming a serious matter. A few years ago ashes had a market value and we could get as much as 8 cents to 10 cents a ton for them. Then a time came when we were glad to get rid of them free of charge. Today we have difficulty in getting the ashes from our stations carted away at

50 cents a ton, paid to the carting contractor who undertakes their removal. It has been suggested that it would pay the large electrical undertakings to purchase 3-ton or 5-ton electrically propelled wagons for the removal of ashes, especially where convenient railway facilities are not available.

Coal Weighing Machinery

Coal-weighing machinery for each boiler or group of boilers is absolutely necessary if proper records are to be made of the boiler-house efficiency. It should always be possible to ascertain the amount of coal used in each 8-hour shift and at the end of each week or month, so that the coal used per kilowatt-hour generated may be ascertainable. These weighing machines should preferably be fixed between the overhead coal hopper and the boiler stoker, but some stations in the United States have a travelling gantry, fitted with a weighing machine at each end, the gantry travelling along the whole length of the boiler-house between two rows of boilers. The duty of the operator on this gantry is to move up and down the boiler-house and to weigh out regularly to each boiler a predetermined amount of fuel. Feed pumps may either be of the direct-acting type or centrifugal, although experience with the former is so good and repairs so low that it will be difficult to displace them. The total condensate from the turbine-room condensers should be measured by a Lea or other water recorder, and this should have an integrating attachment.

Having ascertained the amount of coal used and having measured the condensate, we can get the amount of water evaporated per lb. of coal used. No very great increase in the efficiency of steam boilers can be looked for. The heat balance of many of the steam plants in operation at the present day is as follows:—

Heat absorbed by boilers 78 per cent.
Heat lost in flue gases 15.5 per cent.
Heat lost in radiation and unaccounted for .... 6.5 per cent.

That is to say, the total loss on which any reduction can take place is 22 per cent., but it is only a small proportion of this figure that can be attacked with a view to lowering it. It would be doing negative work to discharge the gases from a boiler at a temperature lower than that of the water in the boiler.

The Evaporation Feature

An evaporation of 4 lbs. of water per square foot of heating surface in the boiler was, until recently, considered standard practice, but to-day water-tube boilers are designed, in conjunction with special economisers, to evaporate at the rate of 6 lbs. normal load, and at overload 8 lbs. and even 10 lbs. per square foot of heating surface of the boiler. The heating area in most water-tube land boilers is of the order of 50 times that of the grate area. With such proportions the general practice is to emit the gases from the boilers at a temperature 500 to 550 deg. F., i.e., from 100 to 150 deg. F. above the temperature of the steam at the boiler working pressure. The proportion of heating surface in economiser to heating surface in boiler varies in neary every station, but the figure of 35 per cent. may be taken as a fair average.

With such a proportion, allowing for heat drop in flues, the gases at the outlet to the chimney will have a temperature of from 300 to 350 deg. F. and the economiser will have utilised about 7 per cent. of the heat of the gases emitted from the boiler. The inlet water to the economiser from the hot-well will, with present-day practice, be raised to a temperature of 200 or 220 deg. F. Until recently the evaporation per square foot of heating surface of boiler and economiser combined was therefore roughly 3 lbs. per square foot of heating surface. Modern practice tends to diminish the heating surface in the boiler from 50 times the grate area to 35 times the grate area and to increase the area of the economiser to 80 per cent. of that of the boiler heating surface. The result is to put up the evaporation of the boiler at overloads to 8 lbs. per square foot of heating surface, and the temperature of the gases now emitted from the boiler is considerably raised, being about 650 deg. F. The heat, however, is taken up in the economiser and the temperature of the feed water to the boiler is considerably increased. The net result is that we get an evaporation of 4½ lb. per square foot of heating surface of boiler and economiser combined. The over-head economiser is suitably proportioned to give the very highest combined efficiency.

Boiler plants arranged in this way probably give a higher efficiency than was the case with previous designs, inasmuch as the radiation losses are less and the loss between the boiler and the economiser is reduced to an absolute minimum. The modern tendency is, therefore, to supply feed water to boilers at a temperature as near as possible to the temperature of the water already in the boiler, and the boiler simply adds latent heat and superheat to the steam. Each boiler has its own economiser and the economiser is really an integral part of the boiler unit.

Fuel.

An electric power station is simply a factory for the conversion of the chemical in coal into electrical energy. Coal is therefore the raw material of the factory; and as the final product alike as regards reliability and price, depends first and last upon the quality and the regularity of tne supply of coal, the selection and purchase of fuel are matters of the most vital importance. The selection and purchase of fuel is a question naturally dependent upon the geographical position of the site relative to the nearest coalfields, and upon the nature of the load. Power stations near the coalfields can use low-grade fuel with resultant saving in the coal bill, whereas it is often more economical to use high-grade fuel in stations remote from the coalfields, as the same freight has to be paid for ash as for carbon.

The kind of fuel also depends upon the nature of the load, as it is a recognised fact that a higher overload duty can be obtained from a boiler fired with good-quality coal with a given draught than can be got with low-grade fuel. If a station has a purely lighting load, and consequently a low load factor, a larger number of reserve boilers with their resultant radiation losses, etc., have to be kept under steam to meet any sudden peak loads than would be the case in a power station where the load is chiefly for power purposes, and consequently the load factor is high. In the former case it is often more economical to use the best coal, because, with the higher overload thus made possible, the number of spare boilers can be kept down to a minimum.

It is now almost universal practice to buy fuel on a calorific basis, but it must always be remembered that along with calorific value and analysis there are to be taken into account physical properties. For instance, two samples of coal may show an approximately similar calorific value figure and present wide differences of behaviour in the furnace. Actual boiler tests must therefore be made with sample truck-loads of coal if the best and most economical selection is to be made. Anthracite coal with very high calorific value will only burn economically at the rate of 8 to 10 lbs. per square foot.

Calorific Value of Coal

I would certaily not advocate a slavish adoption of the calorific value basis in the purchase of coal, for the simple reason that coal is not a manufactured article but a natural product. If we hold the colliery owner or his agent responsible for its calorific value, he will undoubtedly, and quite properly, cover himself by increasing the price accordingly. Again, if the coal contractor is not tied down, the customer is sharing the risk inseparable from the natural product. The contractor can be and should be generally tied down to supply from particular pits. In the Glasgow Corporation Electricity Department the calorific value of the different kinds of coal offered is judged by the previous year's experience, and if any particular kind of coal as delivered is below our previous year's experience of it, then that coal has a decreased figure of value allotted to it against the time when next it will be again offered.

A practical test in a boiler specially equipped for the purpose is a very reliable guide to calorific value. The results of such tests should be reduced to a common basis. A good unit of comparison is the cost of evaporation of 1,000 lbs. of water from and at 212 deg. F., or the number of lbs. of water evaporated for a cent's worth of coal, including coal and ash handling, which varies with the quality of the former. It is usual to express the coal economic result for the whole station in lbs. of coal per kilowatt-hour generated at the switchboard; but as this must obviously vary with the calorific value of the coal and the steam consumption of the engine or turbine plant, the better unit to use for general comparison is the British thermal unit per watt-hour, i.e.

lbs. of coal per unit × B. Th. U. in coal as fired ÷ 1,000

Even this is not perfect, as it does not allow for the variation in load factor between different power stations, but it does enable comparisons to be made irrespective of variation in calorific value. In two of the Victoria Falls power stations, the economic result obtained in the way proposed gave in one station 27 B. Th. U. per watt-hour, and in another 26. Both of these stations had very high load factors, whereas in many of the London stations, where the lighting load is predominant, the average result is in the neighborhood of 40 B. Th. U. per watt-hour. Daily samples of coal, as delivered, should be sent to the laboratory of the undertaking for calorific analysis. An assistant, working with a bomb calorimeter, can test 12 samples a day working from 9 to 1 and from 2 to 5 o'clock. These tests are recorded in a coal test-book for reference. As the results of tests obtained by any or all of the methods above referred to are tabulated and arranged, an index of the pits in the coalfield, from which the fuel supply is mainly or wholly drawn, can be compiled, and coal prices as received can be equated on a calorific value basis.

An interesting experiment has been carried out in one of the Glasgow gas works recently. Gas-coke breeze or gas-coke riddlings were burned successfully on chaingrate stokers with forced draught. A special form of arch had to be built. This breeze can be bought at 20 per cent. the price of coal and it has a calorific value of at least 60 per cent. of coal. There is a large amount of ash, but the experiment went to show that with intelligent superintendence good results could be obtained with this class of fuel, although the actual output of the boiler was considerably reduced.

With regard to the whole question of fuel, experience seems to show that it is preferable to buy the best, for while good results may be obtained with inferior fuel, careful and constant attention to the fires is necessary with fuel, whereas with first-quality fuel very little attention is required.

Boiler-House Staff.

Twenty years ago a fireman in a generating station was truly a fireman. Stripped to the waist, he had in many cases to lift every lb. of coal from the floor level to the furnace door. He had to be continually opening and shutting furnace doors and stirring up the fire. At regular intervals he had to bear excessive heat and noxious fumes, removing ashes from the furnace, which had thereafter to be wheeled away or shovelled direct into carts. It was no uncommon thing in such a boiler-house to have the fireman boasting that he had tackled the load with three boilers, whereas he might have saved both labour and fuel by having four boilers going.

All this has been or will soon be changed. The firing of the boiler is now done by operating a rope or a lever. A fire has rarely to be stirred or nursed in any way except by the adjustment of dampers and rate of feed. The substitution of mechanical and electrical machinery for hand labour naturally led to the substitution of the boiler-house engineer for the aforetime fireman. A competent boiler-house engineer is an indispensable adjunct to the boiler-house staff, and the man who knows his business can easily earn the substantial salary which he can command in this capacity. He, of course, trains his own labourers, but the human element should be, and is being, cut down as far as possible.

Wastage of Coal Heat Value

Everything possible should be done to obviate wastage of the heat value of coal in the boiler-house before the steam reaches the turbine. Many opportunities for waste, and consequently opportunities for devising ways and means to avoid waste, are still present in the boiler-house. In the present paper the possibilities of further improvement have been indicated as regards space, material, heat, labour, and time; and the sum total of the saving which would accrue even from the partial elimination of present waste under these various heads would represent a considerable proportion of the total charges on revenue in a large electricity supply undertaking. A saving of 1 per cent. in the coal bill of the Glasgow Corporation Electricity Department would this year represent a sum of $10,000.

It is only in recent years that we have come to realise the meaning and the value of a lb. better steam consumption in a steam turbine. We now put a money value on steam consumption per

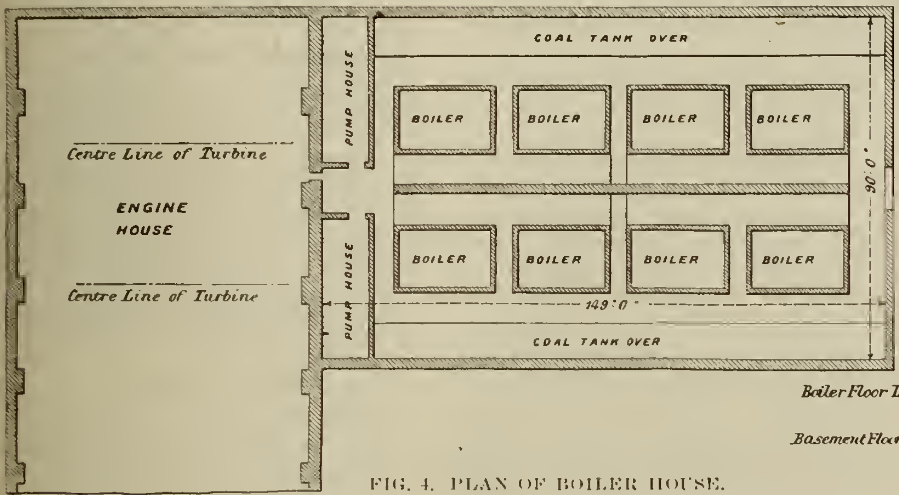

FIG. 4. PLAN OF BOILER HOUSE.

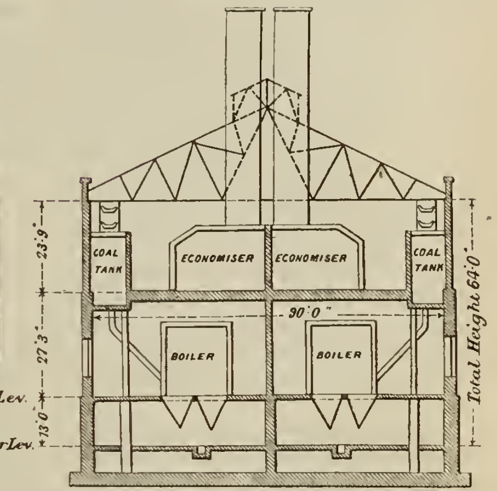

FIG. 5. CROSS SECTION OF BOILER HOUSE.

1-16th of a lb. and stipulate for heavy penalties in the event of failure to comply with guaranteed consumption after allowing a tolerance of 2½ per cent. With an equipment such as has just been described, weekly returns can be prepared giving all the particulars any manager wants to satisfy himself that the plant is being properly handled and is doing its work efficiently. Turbine-room data being also available, a weekly sheet showing running statistics may be easily made out. An exchange of such data between undertakings of about the same size would be mutually beneficial.

Recently in the *New York Electrical World* (April 8, 1916), a short but exceedingly interesting description was given of methods of handling boilers in a 100,000-kw. station. This referred to the boiler plant in the "L" station of the Edison Electric Illuminating Co., at South Boston. The editorial referring to the article says: "It is evident in this central station that the electrical end of the establishment has no monopoly of scientific management," and continues that "the liberal use of recording instruments in the steam end of the station and the continuous expert study of operations . . . are all-important factors." The engineer in charge of the boiler-house is expected to maintain the highest efficiency possible with an economical expenditure of time and labour.

In this station, containing 48 boilers, they have 36 steam-flow meters, 40 draught-gauges, 2 furnace indicators, 1 CO_2 recorder, 2 coal scales and 1 load indicator. In American stations generally considerably more attention is now being given to boiler-house economy, no doubt due to the increasing price of fuel. The workmen in the boiler-house are educated to interpret the various gauges and recording instruments an encouraged to take an interest in improving cordítions. The instruments are not to be erected and stored away in the chief engineer's room, but are to be in the boiler-room.

Efficiency Records

Several very fine records of efficiencies have been attained in the United States. At the Couner's Creek plant of the Detroit Edison Co., which has been in opertion for over a year, they have two 20,000-kw. turbo-alternators, and each turbine is supplied with steam by two large boilers, each boiler containing 23,500 sq. ft. heating surface. The plant is operating at the present time and producing a kilowatt-hour on 1.42 lb. of coal, i.e., a little less than 20,000 B. Th. U. per kw. hour. This shows an efficiency from coal to electrical energy of 17 per cent. The Chicago Commonwealth Edison Co. in their Fiske-Street Station have two turbo-alternators of 20,000 to 25,000 kw. capacity. Over a whole year's run the coal used per unit of output was 1.92 lb., and the average value of the coal as fired was 10,120 B. Th. U. per lb. This gives an average of heating units in the coal as fired per unit of output of 19,450, and also shows a thermal efficiency of some 17 per cent.

* * *

ELECTRIC LIFT TRANSMISSION

THE most essential part of a lift is the driving sheave, or alternatively the drum. There used to be a great difference of opinion as to the rival merits of the drum and sheave, but the principle of the driving sheave is now admitted to be the better. In a sheave lift the ropes only pass a half turn more or less round the driving sheave, the grooves of which are cut at such an angle as to give the necessary grip to the ropes with a minimum of distortion. In a drum lift the ropes are anchored to the drum at one end and wind up upon it in a spiral groove cut upon its surface. The advantages claimed for the drum are, that, owing to the grooves being made to the shape of the rope, instead of being veed, the rope life is longer. This, however, is only the case provided the drum is large in diameter.

A drum of small diameter now usually employed is more destructive to the ropes than a sheave of large diameter, which is essential when the gear is situated at the top of the well and leading wheels are not employed. With a drum drive a standard gear may be made up and used for lifts of different dimensions. The same can be done with the sheave device, but by so doing one of the great advantages of the system is lost, viz., the saving of all leading wheels and the attending losses and rope damage. The disadvantages of the drum drive are the impossibility of slip in case of overrunning. This means that if limit switches and limit safety devices fail, something must break, as the ropes are positively driven from the drum. This difficulty necessitates the introduction of additional safety devices, which are unnecessary with sheave driving.

Sheave Drive

With a sheave lift, in the event of overrunning, either the car or the counterweight lands upon the buffers, and the tension being so removed from the ropes, the driving sheave can continue to revolve under the ropes with no risk of anything serious happening. This state of things has been known to exist during a whole night, and the ropes to show no serious wear in the morning. The advantage of increased safety alone is sufficient to recommend sheave driving, as compared with the drum winding system, but there is a second advantage. With a sheave there is practically no limit to the number of ropes which may be employed, whereas if a drum is to be kept to reasonable dimensions the number of ropes must be reduced to a minimum in order to find room for them to coil on the drum. As a consequence it is usual to find four ropes to a sheave-driven lift against two on a drum lift driven lift against two on a drum lift.

To obtain equal strength, the ropes on the drum lift must be larger in diameter, and in consequence will suffer more from bending round the drum and leading wheels. The grooves must be cut with care to the exact angle to ensure correct driving with minimum wear on the ropes. It is a frequent business to re-cut the grooves on the sheaves of old lifts coming under maintenance contract in order to reduce the annual rope bill. The driving sheave should be as large in diameter as possible, so as to give a maximum of driving surface and a minimum radius round which the ropes have to bend. This provision is usually amply complied with by making the sheave span from the centre line of the car to the centre line of counterweight.

Leading or Guide Wheels

Leading wheels—that is, wheels to guide the ropes to the required position over the car or counterweight—should, when they are necessary, be provided with spindles giving ample bearing surface, and they should be well lubricated. Passenger lifts are not usually designed for speeds exceeding 200 feet per minute, but the tendency is to increase the rate of travel.

Rope Features

The form of stranding for ropes found to be most satisfactory for all-round lift work is that known as 6-19 in., layered up round a hemp core; 6-24 and 6-30 ropes give much greater flexibility, but the finer wires wear more quickly. A good rule for deciding upon the ropes required is to allow for a set of four ropes a breaking strain of six times full load upon each rope, and for a set of two ropes a similar margin of seven times. Good ropes should not be grudged, for the cost of labor in changing a set of ropes is often as much as the cost of the ropes themselves. When one rope in a set requires renewal it is therefore economy to renew the whole set. The car is supported by a sling of wrought iron which carries four guiding shoes. These must be accurately shaped to fit guides, and preferably be made or lined with gun-metal. They should be mounted upon spring boxes so designed as to maintain them in constant and nicely balanced pressure upon the guides, so that any uneven loading or swaying of the car will be automatically taken up. The pressure of the springs in the boxes should be capable of regulation.—From a paper read before the Association of Supervising Electricians.

Light, Heat and Ventilation

DATA RELATIVE TO HEATING AND HEATING SYSTEMS—V.*

By T. W. Reynolds.**

MODULATING or graduated control valves cannot be used on an ordinary gravity return pipe system unless the latter is either vented to the open or operated under a vacuum. The partial throttling of the supply to a radiator would produce a lower pressure in same, thereby resulting in back pressures from other sources. Pressures above atmosphere may be used in connection with the vented system, providing the vent pipe is equipped with a swing check valve set to close against any pressure in the system.

The usual air valve (that most annoying of all contrivances, heretofore regarded as a necessary evil) is not required on the radiators, all of the air being sucked out of the system by the vacuum pump C, but a return-line valve G, designed to close when steam hits it, is used to prevent steam passing into the return line, and from there through the vacuum pump C. A similar ''drip'' valve D is used at the end of the steam main which allows air and water to pass into the return, but closes against the passage of steam. Located above the vacuum pump C and the feed or return pump A, it is desirable to have a ''separating'' tank L, which separates the air and water from the return lines.

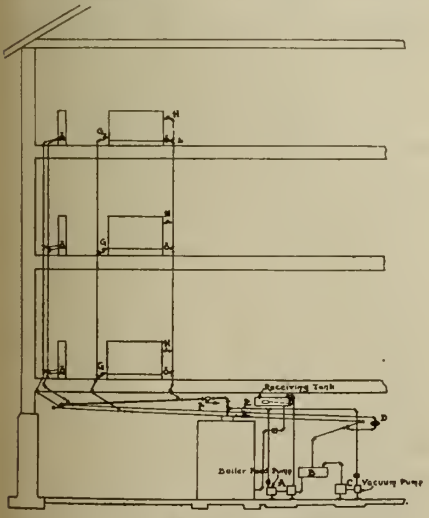

FIG. 8. VACUUM-STEAM MECHANICAL VACUUM SYSTEM, TYPE "A."

Certain admirable features are possessed in a similar system (see Fig. 9).

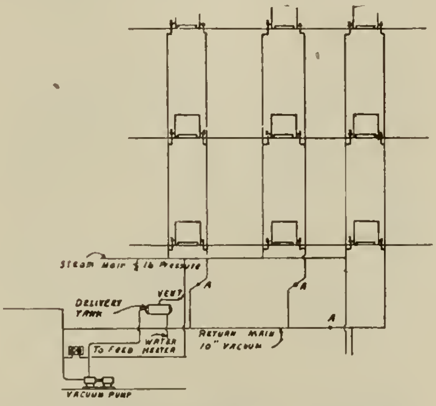

FIG. 9. VACUUM-STEAM MECHANICAL VACUUM SYSTEM, TYPE "A," USING SPECIAL VACUUM CONTROL VALVES.

The amount of vacuum carried is controlled by means of differential weighted check valves (with orifices restricted in accordance with their capacity), installed on each branch return, and ''Impulse'' valves on the return end of each radiator; the latter valves have been already described under gravity two-pipe systems. In the cut (see Fig. 9) are shown differential valves, one on each return riser. These are weighted to open at about five pounds difference in pressure.

The loss of pressure, due to the friction of flow in the steam and return mains, varies in accordance with the distance from the boiler, or amount of vacuum carried on the system; therefore, each valve is weighted to correspond to the difference in pressure at the point of its installation. The objectionable features usually present in many systems, that of short circuiting, heating only of those radiators which are nearest the source of supply, etc., are herein avoided, due to the valves which are so weighted, all lifting and discharging equally into the main return, irrespective of their distance from the boiler or from the vacuum pump.

The type B mechanical vacuum steam system (Fig. 10), may be either of the one-pipe or two-pipe plan constructed on the ordinary gravity principle. The condensation from the radiators and pipes is returned to the boiler by gravity. In this system, and ''air line'' is run from each radiator to a pump or aspirator vacuum producer in the basement. This air line is constructed of small size pipe connecting the air valves A which are designed to allow air to pass out of the radiator. but which closes when steam reaches them. The supply valves B should be of the packless type suitable for steam heating work. The aspirator is usually connected with some source of power such as the city water pressure and may be arranged so that a vacuum of 5 or 10 inches is automatically maintained in the air lines.

The principal advantages of the mechanical vacuum systems of steam heating over the ordinary gravity systems is the wider range of temperature which may be maintained in the radiators and the more positive circulation of steam through the system with less back-pressure upon the steam using machinery.

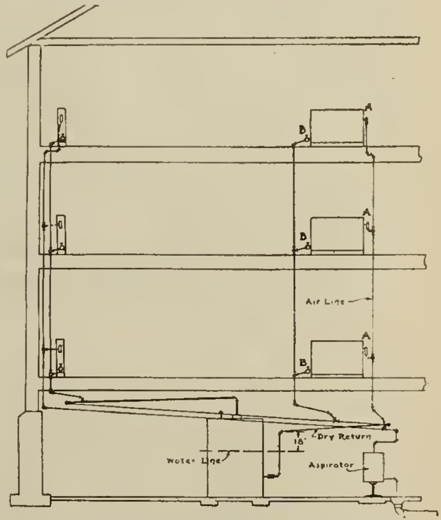

FIG. 10. VACUUM-STEAM MECHANICAL VACUUM SYSTEM, TYPE B.

Pipe sizes can be much smaller because of the greater differential pressure than is present in the ordinary gravity system. The extra cost of modulating and vacuum valves is partially offset by a saving due to the reduced sizes of pipe and the elimination of air valves.

This type of vacuum system works as

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*Parts I., II., II. and IV. appeared in our March, April, July and September issues, respectively.

an ordinary one or as a two-pipe steam installation except that all of the air relief valves are designed to permit the air to be forced from the system under one or two ounces of pressure but which close against the entrance of air from the outside when the steam within the radiators condenses and creates a "self induced" partial vacuum. Usually these air relief valves are connected by a small size air line leading to a condenser radiator C (Fig. 11), located in a cool place and customarily used as an indirect radiator. Sometimes the air lines are connected to one large air relief valve which is located in the basement. The condenser radiator C serves the purpose of aiding this self-induced vacuum, and when used as an indirect radiator probably aids in giving desirable results. A sensitive automatic draft damper controller A must be used to keep the steam pressure in the boiler as low and constant as possible. The use of a proper check valve, shown at D, is necessary to maintain a steady water line in the boiler.

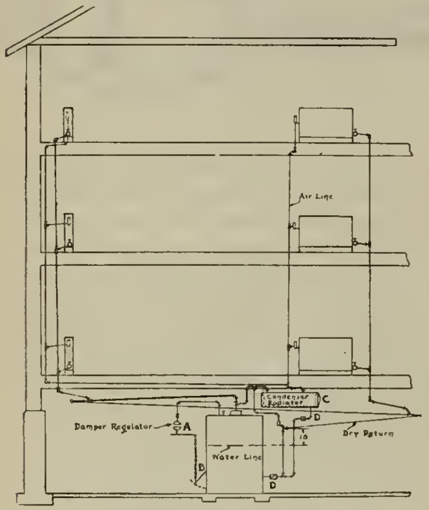

FIG. 11. SELF-INDUCED VACUUM VAPOR SYSTEM.

On account of simplicity of action, the self-induced type of vacuum system (Fig. 11), or the type B mechanical system (Fig. 10), are more suited to a residence heating plant where the attention of an expert cannot be expected, than the type A mechanical vacuum system (Fig. 8). The latter system is no doubt better suited to the larger installations, such as office and large public buildings where it is desirable to maintain a medium pressure of steam for various purposes, and where it can be expected there will be available the services of an expert caretaker for the apparatus.

Warm Air Gravity System

The warm air gravity system of furnace heating (Fig. 12) is cheaper in first cost than other methods of modern heating, it has therefore come into wider use as a convenient method for warming residences. First cost, combined ventilation with heating, and quick response to varying changes in outside temperature make this system popular. On the other hand the circulation of outside air increases the operating cost while the joints at the furnace must be well made to avoid contaminating the air supply with fuel gases.

If properly designed and carefully installed, a warm air furnace system should give as good results as may be desired. It is somewhat more difficult to distribute heated air by the furnace method to the windward side of the house than with the other systems, but the combined system of warm air and hot water heating, shown in Fig. 13, will to a large extent overcome this disadvantage.

Essentials of Warm Air Heating

In addition to careful workmanship, there are several essential features in warm air heating which serve to establish a successful method. The ducts leading to the rooms should be pitched upward as rapidly as possible; they should have easy or long sweep elbows; and should lead as directly as possible to the rooms to be heated. Friction in air pipes is a much more noticeable factor than friction in hot water or steam pipes, for the motive power depends only upon the difference in weight of two columns of air, one hot and the other cold. Care must, therefore be taken to make all conductor pipes as short as possible, while at the same time they must carry heated air to the cold sections of the rooms. A humidifier which will automatically maintain a relative humidity of 50 per cent. in the heated rooms should be installed as a part of the apparatus. Owing to the high temperature to which the air is heated in the furnace before entering the room, its capacity to rapidly absorb moisture from the body or woodwork is so greatly increased that provision should be made whereby this dry air can be automatically supplied with enough moisture to raise its relative humidity to 50 per cent. or 55 per cent. at the room temperature.

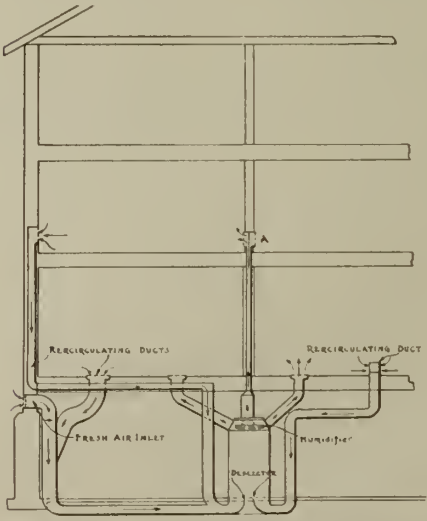

FIG. 12. WARM AIR GRAVITY SYSTEM.

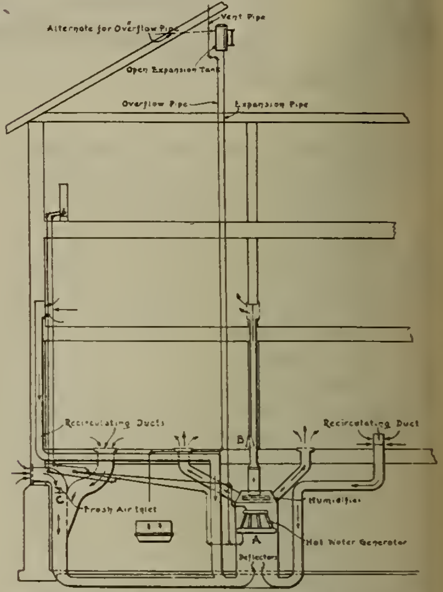

FIG. 13. COMBINATION WARM AIR AND HOT WATER SYSTEM.

It is sometimes desirable to use a single riser duct to supply two rooms when one room is directly above another. A special register B (Fig. 13), may be used in such a case. A damper in this first floor opening which is controlled by a lever projecting from the register face controls the amount of air passing to the upper and lower rooms.

Warm Air and Hot Water Combination

In the combined warm air and hot water system (Fig. 13), a small cast iron heater A (which serves as the hot water generator), is placed in the upper dome of the fire pot of the furnace. Using this heater as a substitute for the hot water boiler, any system of hot water heating which has been previously described may be used in the residence. Often the hot water generator used in the fire pot of the furnace is made too small to properly heat the water.

The radiators used may be of the indirect, direct or direct-indirect type, depending upon the conditions of the building; the degree of ventilation to be supplied, etc. The same methods of piping as given for the hot water systems previously described must be followed. The installation must also be so arranged that hot air will be supplied by the furnace through the shorter runs to the lower floors, while hot water will circulate to the upper or farthest rooms.

The average residence loses and gains enough air through leakage in the walls.

windows, doors, and through the action of stoves or fire-places to supply adequate ventilation in warm weather. It is evident therefore, that the air should be recirculated in residences instead of thrown out through foul air ducts, a large amount of heat being thereby wasted.

The air leakage through the walls, however, does not take place very rapidly when the difference in temperature between inside and outside is small. It seems essential, therefore, that a duct leading from the outside to the base of the furnace should be installed and a series of simple dampers, C (Fig. 13). placed in the ducts to control the quantity of fresh outside air admitted, and the quantity of air which is recirculated. This fresh air opening should always be placed on the side of the house toward the prevailing wind, or two openings may be installed, one on each of two sides of the house and either one used at will in accordance with the prevailing winds.

Air Intake Location

The air intake should preferably be taken from a point opposite the lawn, as this will materially decrease the quantity of dust carried into the dwelling. The recirculating ducts should be constructed on the outside walls and should carry the cold air from the proximity of windows or outside doors directly to a duct under the basement floor which leads to the base of the furnace. The supply risers should always be carried up in an inside wall to prevent the unnecessary loss of heat through the walls, and to establish a rising column of air from their outlets along the inside walls. It will in turn descend along the outside walls as it is cooled by contact with same.

The inside system of supply is more positive as regards circulation than when taken from the outside. To a certain extent even the inside supply is affected by winds which may cause a slight pressure or vacuum to exist in the rooms from which such a supply is taken. That the inside supply affects a lesser cost of installation is not necessarily true. It will depend upon the relative location of the boiler and the source of supply.

In some installations the recirculating duct is connected to a register in a hallway where the air is relatively purer and colder, and where the opening is less of a nuisance than when taken from a living room, the floors of which are covered with rugs. It also allows the return of air from the upper rooms.

More recently there has been established a new method of protecting the outside supply, that which is obtained by the use of a cold air room or chamber into which the air enters directly from the outside. The air becomes tempered before passing to the furnace and only the warmer air is withdrawn from the top of the chamber. The effect is to cushion the wind pressure and precipipitate the dust on the floor of the chamber.

Ventilation may be secured in connection with indirect heating, the radiating surfaces being located in the cellar with a duct connecting these to the outside for the supply of air, and another connecting to the rooms to be heated. Ventilation by direct-indirect heating is accomplished by locating the radiators directly in the rooms to be heated, which they indirectly heat by air taken through openings from the outside. The air from the outside is first warmed by the radiating surfaces before entering the room.

Either steam or hot water may be used as the primary medium for the methods of heating as defined above, but in each case hot air is the secondary medium which does the actual work of warming the rooms. The whole process is simply a transfer of heat from the steam or hot water to the air. When hot water is used in connection with indirect radiators, the latter should not be equipped with valves, otherwise, with the closing of these in extreme cold weather, freezing of the water might result through stoppage of its circulation.

The indirect system possesses certain advantages. All steam or hot water piping is concentrated in a small space from which the heat effect may be easily controlled. The heating surface is more efficient than for equal amounts distributed within the rooms, due to the increased velocity of air inside the flue which connects to the rooms requiring heat. This increases the heat transmission in proportion to the square root of the velocity; consequently the amount of radiating surface would be decreased over that required when direct radiation is used, if it were not for the fact that the air being taken directly from the outside is colder and must, therefore be heated through a wider range of temperature.

* * *

MOTOR DRIVEN CENTRIFUGAL PUMP TROUBLE

A TWO horse-power series motor used to drive a centrifugal hot water circulating pump has on a number of occasions given trouble, says a writer in The Dodge Idea. In the Fall it was given a thorough overhauling to make ready for the Winter use. Shortly after being installed a complaint was sent to the repair shop. A trouble man investigated and found the brushes moved forward about 20 electrical degrees, causing the motor to run much too fast. The power taken by the centrifugal pump varies approximately with the square of the speed, hence a small increase in speed can cause a considerable increase in the load. A resetting of the brushes was all that was required.

About three weeks' service was given when the second complaint was received. This time the bearing had been dry, the bearing wearing enough to allow the armature to strike the field poles and rubbing off the bands. While at the shop this time two new bronze bearings were made, and new bands put on. After a thorough test, the motor was sent out again. Five days later word was received that the motor was not working properly. This time it happened to be the writer's lot to answer the call. The brushes were in good contact and in the correct position. The bearings were full of clean oil, but those bands were off once more. By taking out the armature, bright places on the bottom of the field poles were seen. This indicated worn bearings, but they were tight on the shaft and in the frame. The shaft showed signs of being worn, but it was not cut. It was then supposed that the armature was not properly centred. With this thought in mind the armature and bearings were taken out and replaced by those from a spare machine. Before the new armature could be run it was necessary to do considerable aligning, which added weight to the theory of poor aligning of the injured armature.

The spare field frame, old armature, and its bearings were sent to the shop once more. While cleaning out the oil well, lumps of metal about the size of a grain of corn were found in the bottom of the well. The motor was one of a type, no longer manufactured, having the self-aligning bearing set in a seat of white metal. When the bearing heated, this white metal melted out of one side and let the armature strike the field poles. This motor is running once more and with a little oil it is very probable that it will continue to do so.

* * *

EVERYONE appreciates the necessity of having shafts large enough to be able to successfully carry the load. Shafts must be able to resist the twisting or torsional stresses, and also resist flexure, or that tendency of the load to bend and break the shaft. There is, however, a commercial side to the matter of shaft sizes which is very important and which should always be considered along with the mechanical necessities of each case. Shafting can be secured of almost any diameter desired; and if it were a matter of shafting alone, any size that was properly adapted for the work would suffice.

Electricity and Hydraulics

CARE AND MANAGEMENT OF STEAM BOILERS IN THE CENTRAL STATION PLANT

By W. Kavanagh

IN the plant of the central station, economical generation of steam is an important factor in the cost of energy developed. If the boilers are permitted to become fouled with scale on their interior surfaces and coated with soot and ashes on their fire or exterior surfaces, the efficiency of the metal as a heat conductor will be lessened in a degree depending upon the amount of scale and ashes adhering thereto. The thickness of scale necessary to lessen the evaporative efficiency of a given boiler 7 per cent. is only 0.11 of an inch in thickness, hence the importance of keeping the interior surfaces of the boiler free of scale; it is, of course, equally important to maintain the fire surfaces of the boiler free from soot and ashes, as these bodies not only are non-conductors of heat, but they also aid in producing corrosion.

Let us assume our central station plant is equipped with an extra battery of boilers, the use of which will enable the cleaning of a number of boilers that have been operating sufficiently long to warrant their being cleaned. Steam is raised in the extra boilers which are cut in on the main line under proper conditions. We may now cut out the boilers in need of cleaning and it is at this point usually that the mistake is often made in preparing a boiler for the purpose of cleaning.

Cleaning of Boilers

To facilitate the cleaning of boilers, the following procedure is necessary in order to eliminate unnecessary labor in the removal of scale, and incidentally to prolong the life of the boiler. Having cut out the boilers from the main steam line, pump hot feed water into them a few inches above the usual water line, close all dampers and doors and allow the fires to burn out as slowly as possible, and do not permit cold air to enter the furnace or strike the boilers at any point. The cooling of the boilers will, of course, depend on their size, the quantity of water they contain, amount of incandescent fuel in the furnace at the time the boilers were shut down, and also on the thickness of the walls forming the boiler setting.

This cooling and at the same time annealing process should occupy at least three days, or until the temperature of the boilers has fallen to that of the atmosphere in the boiler-room. The boilers are now in a condition to open for cleaning and inspection, so, having run off the water, we may now open the manhole and handhole plates and wash out the boilers with warm water or water not less than 100 deg. Fahr. The water should be played around the flanged portion of the heads and between the tubes and the scale and sediment thrown down on the shell from the action of the water can be hauled out by means of a long-handled hoe.

Ventilation Necessary

When this process is over, the boilers should be well ventilated, before entering, or placing a light, such as an oil lamp or candle inside. The best way to test the boiler for an explosive gas is to attach a piece of oily waste to a long handle or stick, light the waste and touch the handhole or manhole opening with the flame and if an explosive gas be present, it will immediately take fire and its force be dissipated through the openings in the shell. Testing the boiler for an explosive gas is a very important operation and this is especially true if anti-scale compounds, or crude oil have been used in the boiler for the purpose of preventing the formation of scale. The use of the long stick enables the person making the test to stand away from the opening, and if an explosion should occur the column of lighted gas issuing through the handhole or manhole, as the case may be, cannot reach the person holding the light. If the boiler be free of dangerous gas, it may be entered for the purpose of inspection and removal of scale.

Removing the Scale

When the boiler is of the horizontal type, scale will likely be found between the tubes and around the flanged portion of the heads. It is sometimes a difficult matter to loosen the scale between the tubes, but, if we adopt the plan shown in Figs. 1 and 2, we can easily remove the scale lodged in such places. Fig. 1 illustrates the method of using the flat, straight bar between the tubes in a longitudinal direction, and Fig. 2 shows how a tee-shaped bar may be employed for the removal of scale lodged between the tubes in a crosswise or lateral direction. The swinging of the bar along the tubes will break up any scale lying in its path, the broken scale falling on the crownsheet, from where its removal becomes an easy matter.

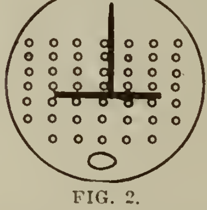
FIG. 2.

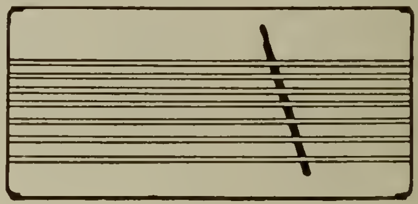
FIG. 1.

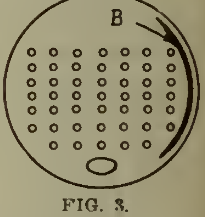

FIG. 3.

Frequently the removal of scale from around the front and rear head flanges is a difficult task; if, however, we employ a curved, flat bar, as shown in Fig. 3, at B, its use will be found of great assistance in removing the heavy, hard scale usually found in this vicinity, encrusted onto the rivets and flanges of the boiler heads.

After all the scale possible has been scraped off the metal surfaces, a strong stream of water from a hose may be played between the tubes in all directions, around the flanges of the heads, and along the water line of the shell. Under the influence of this stream of water all, or nearly all, of the scale will be thrown down on the crown sheet from where it can be removed by means of a long handled hoe. Before beginning the operation of washing out the boiler or removing the scale therefrom, it will be found an excellent plan to plug the blowdown opening in the shell; by so doing it will prevent scale and sediment from entering the opening and clogging up the blowdown pipe and connections, which should be kept free from obstruction. After the scale is removed the plug can be taken out of the opening and the boiler is then ready for closing.

Oiling the Interior

If the water used for steam making is impregnated with scale forming properties, it will be found an excellent plan to paint the interior of the shell and tubes with a quantity of crude oil. After the manhole plates are in position, we can pour into the boiler through the manhole opening, two gallons of crude oil for each 100 lbs. the boiler is capable of developing, after which the manhole may be closed and warm feed water allowed to enter the boiler slowly. Allow the entering water to rise above the usual water line, at which point close the feed valve and open the blow-off valve an amount that will permit the water to run off very slowly. In some plants the oil is not run out of the boiler at this first operation, but instead it is raised and lowered a number of times so as to compel the greater portion of the oil to adhere to the surfaces of the boiler and tubes.

After the interior surfaces have thus been treated we may now run off the remaining oil and fill the boiler with fresh hot feed water to the regular height and proceed to clean the fire surfaces of the shell and tubes. In cleaning the fire surfaces, it is important to run the tubes with a tight-fitting brush or flue scraper, beginning with the upper row and finishing with the lowest row of tubes. After running the tubes use a strong blast of air or dry steam and blow off the soot and dust lying on the shell. If air or steam is not at hand, the crown sheet and heads may be swept with a stiff corn broom having a long handle, which will enable nearly all important parts of the boiler shell to be reached.

If the boiler, or boilers, are to remain idle for some time, paint the heads and shell with red lead, and if this cannot be done, build a small fire in one corner of the furnace and keep it burning.

One of the most destructive influences on the life of an idle boiler is oxidation and every precaution should be taken to guard against corrosion. The slow fire, as above mentioned, is an excellent plan for protecting the metal against this action, and if the boiler be kept full of water, the inner surfaces will in like manner be protected.

Raising Steam

The raising of steam should be done as slowly as possible. The fire should not be started with wood, as its use induces corrosive action; a better plan is to take incandescent fuel from other furnaces and with it start the fire. Do not hurry the fire, but allow it to burn gradually and when a sufficient quantity of lighted fuel is obtained spread it evenly over the grate and cover lightly with fresh coal. Permit the boiler and connections to rise slowly in temperature and when steam begins to form, increase the draught and allow the fire to approach its maximum degree of heat. Before the steam has reached the desired pressure, the safety valve should be tested for freedom of action, and the gauge cocks and glass should also receive attention.

Cutting In

When cutting in the boiler on the main steam line, it is important to guard against water hammer and if the boiler is equipped with a by-pass valve, it should first be opened and when equalization of pressure is attained, the stop-valve on the boiler can be opened, after which the boiler will again be doing its regular work.

The frequency with which the tubes should be cleaned depends in a measure on the quality of fuel employed. If soft coal is used the tubes will need to be blown at least once in each week, and if hard coal is burned in the furnace, once in every two weeks will be sufficient; but, in general, the tubes should be blown every week. If now the boilers be properly fired and treated as above described, they will be capable of evaporating more water per lb. of coal than boilers improperly handled, and the longevity of the boiler receiving such treatment will be considerably increased.

FUEL ECONOMY AT COLLIERIES[*]

By F. F. Mairet.

A COMPARISON between the heat units utilized at an average colliery with those utilized at a modern steam plant, such as a generating station, shows in a striking manner the possibilities of economy in colliery steam production. The writer, from data in his possession, puts the colliery result at 1.7 per cent. of the heat units produced from the fuel burnt, while at the generating station 8 to 9 per cent. are converted into work. The one result is less than one-fourth of the other. The conditions are so different, however, that it is impossible that the same result can be attained at the colliery as at the modern steam plant, yet some considerable leeway may be made up. With the increase of the wage bill the cost of all coal has also increased. It has, therefore, become urgent to turn into profit coal hitherto lavishly burnt.

Steam Generation and Distribution

Of the heat produced in colliery boilers only about 50 per cent. is absorbed in the water. This low efficiency is in part due to causes which would obtain under the most favorable conditions; but there are other losses which are attributable to special bad conditions which frequently exist at collieries. With low grades of fuel there is a tendency to increase the excess air—no doubt to force combustion. This could be attained by using heated air, preferably as dry as possible. Some makers of forced-draught apparatus claim a saving of from 15 to 25 per cent., but although the writer does not believe that these test results are maintained, there is little doubt that, with the lower grades of fuel, a greater saving even than this might be attained. On the other hand, a saving of 15 per cent. on low-grade fuel would not permit of the same capital outlay as on the same percentage of good coal; but in the case of a colliery all available unsaleable coal of a sufficient calorific value would be burnt, being merely supplemented as required by good coal, therefore, all savings up to a certain point would be saleable product.

Loss of Heat Prevention

A plain statement of the actual loss in British thermal units does not always appeal to the steam user to the same extent as the actual loss in pounds of steam, coal, or dollars and cents. A particular case in the mind of the writer is a range of 8 in. internal diameter naked steam pipes conveying steam from the boilers to an engine 294 ft. distant. With the temperature of 307 deg. Fahr., which corresponds to the steam pressure, the actual loss due to condensation is 1.5 lbs. per run of pipe, and allowing 34 flanges each equal in surface to 1 ft. in length of pipe, this represents 492 lbs. of steam condensed in transit. With such boilers as obtain in the average colliery, viz., 50 per cent. efficiency, this represents 90 lbs. of coal per hour.

The ideal material for non-conducting covering appears to be slag-wool (or silicate-cotton), both on account of its high non-conductive and non-inflammable properties. Silicate-cotton owes its non-conducting property to the fact that it encloses the greatest possible number of microscopic air spaces by refractory surfaces. At a recent investigation on behalf of the Bureau of Mines, U.S.A., it was found that with a non-conducting wall consisting of air space enclosed by two firebrick walls, while there was a considerable drop in temperature from one side of the firebrick wall to the other, the two adjacent surfaces thereof were practically of the same temperature, proving clearly that air in bulk is a poor non-conductor on account of the convection currents set up. This indicates that it is most necessary for air spaces to be microscopic in order that they may still contain air.

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[*] Abstract of paper awarded the Ellison prize, read before the Midland Institute of Mining, Civil, and Mechanical Engineers.

Winding and Hauling Engines

Amongst the steam engines used at collieries the most important are the winding engines. The load factor in such an engine is very low, being in the neighborhood of 7 to 15 per cent., depending on the load, speed of wind, and depth of shaft. It has been shown that electric winders are less economical than steam winders, but they are nevertheless being increasingly adopted in Germany, South Africa, and elsewhere. It occurs to the writer, in this connection, that this is a point which is open to question, it not being sufficient to merely calculate the horsepower hours given out by the winder for a given consumption of steam, since this is admittedly an extravagant steam user, but rather to calculate the extent to which winding electrically will lower the load-factor on the generating plant. Electrical winders, although absorbing a very large amount of power to produce the necessary starting torque, impose very short peaks on the generating plant.

Hauling engines are a class of engine which, unless very liberally installed at the outset, are usually working up to their full capacity, if they are not overloaded. If the engine is drawing coal up an incline, it is loaded up to nearly the last tub it can haul. With an endless-rope system of haulage, the conditions are somewhat more favorable, and in some cases expansion gear is fitted, but even in such cases the result is but moderately economical. Small air-driven haulages underground are always most extravagant users of compressed air, which is, in its turn, under the most favorable conditions, as low in efficiency as 25 per cent. The overall efficiency must be exceedingly low when one takes into consideration the long ranges of pipes feeding them and the poor class of joints generally used. The writer has in mind a case of a compressed-air system where, although no leakage could be heard throughout the entire pipe-line, yet absorbed 1,000 cubic feet of free air per minute at 60 lbs. pressure to maintain the pressure at this figure.

Prime Mover Types

Prime movers for the generation of power take various forms, from the horizontal, slow-speed engines belted to generators, to the modern high-speed, direct-coupled type. Belt or rope driven sets are not recommended on account of their low efficiency, inability to take high-peak loads, cost of upkeep, and space occupied. Radiation losses are considerably higher for unit power as compared with the high-speed sets, on account of the larger heated surface, which must be exposed to the atmosphere owing to the lower speed. Vertical high-speed reciprocating sets have in the last few years reached a high state of efficiency and reliability, and there is little doubt that they form the most efficient steam-driven prime mover up to about 300 kw. The makers have designed these engines that reversal of the stresses is so gradual that forced lubrication is sufficient to keep the bearing surfaces from coming into contact. For powers above 500 kw., there is no question but what turbines are the most suitable. At almost every colliery there are a large number of small steam engines, all probably uneconomical in view of their small size and the condensation in the steam pipes leading from the boilers. There is sometimes a big drop in the steam pressure with these small units, and oftener a high back pressure.

Taking all these circumstances into consideration, is it not inevitable that the cost of producing power in collieries by the use of steam alone must be exceedingly wasteful, and would be much more economically dealt with by electric motors? It is interesting to try to analyze how the fuel consumed is used, and the writer has taken out the figures in the case of one colliery:—

The coal consumed over a period of 18 days was 839 tons, which it was calculated produced 22,251 millions of British thermal units under the conditions existing at that time. Of these heat units produced, it is calculated that 1.7 per cent. were utilized in the performance of useful work, the balance being lost in boiler losses, radiation, latent heat, inefficient engines, and the general conditions of operation. The demand for power was very unfavorable to an economical result. The winding and hauling engines worked intermittently, especially the former. The accompanying table gives the percentage of total heat units absorbed by the various engines:—

Powers used for	Approximate H.P. Average	Approximate H.P. Maximum	Hours per day in use	Constant or Intermittent.	% of total units.
Winding	100	900	16	Intermittent	14.2
Hauling	265	550	16	"	17.6
Air compressing	200	350	24	Variable speed	17.6
Fan	235	...	24	Constant	26.2
Other engines	100	400	12	Various	25.66*

*The high consumption of the various engines is due to their small size and condensation resulting from long pipe connections.

Condensation, Compounding, Turbines

Wherever a plentiful supply of good water is available, considerable economy may be effected from condensation. It is, indeed, essential where steam turbines are used, and where the water supply is limited, recourse must be had to water coolers. Surface condensers are preferred where the condensate is required for boiler feeding if the cooling water is of a readily scaling or corrosive nature. The majority of jet condensers are so arranged that the removal of scale is more easily performed than with surface condensers, as there is but a fraction of the area to be scaled. It is present-day practice to effect condensation in a condenser of the rotary type with which, on the accumulation of an undue quantity of water in the impeller, greater centrifugal force results, due to the higher specific gravity of the mixture in the impeller. With this arrangement, provided the speed of the impeller remains practically constant, no flooding back is to be feared.

The various types of steam turbines differ as to the manner of expending the steam, and the arrangement which would give the best efficiency has had to be more or less modified to produce a practical machine. Present-day practice is more or less the result of a compromise between such factors as steam economy, strength, cost of construction, size, weight, factor of safety, leakage losses, and steam temperature. Up to the present, impulse turbines have met with great success on account of their simple form, which is not liable to distortion with the pressure and temperature necessary for their efficiency. It would appear, however, that the reaction turbines should give better results provided it were possible to use steam of the same temperature as the impulse turbines. Theoretically, the reaction turbine is the best, but the impulse turbine has the advantage over the reaction type that it has no guide blades to cause friction, and it occupies less space.

Electricity and Power Distribution

The advantages of generating power on a large scale have long heen appreciated, and in this direction it has been demonstrated that central stations are generably able to provide power at a very low figure. This advantage must, however, be, to a certain extent, discounted by reason of the transmission losses which occur to a greater or less extent, depending upon the flux density, distance and power factor. In large central power stations feeding a large area the transmission losses are naturally greater than if the same area were fed by a number of smaller stations, and in view of the waste-heat or coke-oven gas available at collieries, it is evident that much economy might be effected by linking up a number of power stations and collieries.

Gas Engines

As a means of generating power the gas engine is about equal in point of cost with the most modern type of steam generator—including modern turbines. The comparison between reciprocating steam engines such as are found at collieries, and the low efficiency which has already been referred to, shows an immense waste of fuel and heat value. At the Carville works of the Newcastle and District Electric Supply Co., current is generated at a cost of .264 cents per unit produced, and the coal cost to produce a unit is only 22 cents. That is, the coal cost per horse-power hour is considerably under .2 cents.

Where collieries have by-product coke ovens, the surplus gas evolved in the coking process furnishes a source of power which, if not utilized, is wasted. With a good class of bituminous coal and generator ovens, 50 per cent or more of the gas in the coal is surplus, so far as the heat required for the coking process is concerned. At Wharncliffe Silkstone Collieries, with 35 non-generator and 15 regenerator ovens (Simon-Carves system) 1,300 H.P. are being obtained daily and utilized in gas engines. If the whole 50 ovens had been regenerator ovens, 2,000 H.P. would be easily available from the same quantity of coal. The calorific value of the gas is about 430 B. Th.U., and although difficulties owing to the richness of the gas were at first experienced with the gas engines, they have now been overcome, and no trouble has been experienced from this cause for some time past. The power is used both for generating electricity and compressing air, as well as for driving a ventilating fan.

Electricity	800—1,000 H.P.
Compressed air ..	200— 300 H.P.
Ventilating fan ...	220— 220 H.P.
	1,300—1,520 H.P.

If this power had to be generated from steam on the load-factor and conditions prevailing, the lowest consumption which could be expected is some 2½ lbs. of coal per hourse-power hour.

Gas Engine Reliability

Much has been written to prove that gas engines are thoroughly reliable machines, but such is somewhat cold comfort for one who has a troublesome case to handle, and it occurs to the writer that a few troubles from his own experience, and the remedies applied, may be useful. Cylinders and piston rods are always lubricated by fresh oil, and not more than is sufficient for the purpose should be used. Excess oil will form carbon, with the attending risk of pre-ignition. Bearings are sometimes fed by drop-feed lubricators, but, except for the smaller sizes of engine, this system is not to be recommended on account of the high oil consumption. The method to be preferred with large engines is forced feed, so arranged as to supply sufficient oil to flood the bearings, the drainage falling into the bedplate, whence it draws through filters, pumped through the oil cooler, and returned to circulation. The oil consumption with this system is as low as 3 gallons per 24 hours for 1,000 H.P., and renders local heating almost impossible.

Pre-ignition may occur from several causes: (1)—Incorrect mixture may be so proportioned as to burn in a manner more or less active (depending on the proportion of gas to air), for a considerable time. In a case of a 4-cycle engine, if the mixture is such that combustion continues during the expansion and exhaust strokes, the fresh charge drawn into the cylinder (which on the same load is identical in composition) meets the incandescent contents of the cylinder, and, in its turn, burns throughout the inlet stroke. The burning or combustion becomes far more intense on the compression stroke, and forms what the writer, for the want of a better name, terms "false pre-ignition." This cannot really be called "pre-ignition" since the cylinder has contained flame for practically the whole cycle. It is but rarely that this trouble is encountered except with gas of a high hydrogen content, such as coke-oven or town gas. Dilution of the charge with a sufficient quantity of inert gas is sufficient to overcome this trouble.

(2)—With a multi-cylinder engine, overload may occur, due to the refusal of some of the cylinders to take up their proper load. This may be due to a throttling of the charge or misfiring. The importance of reliable ignition cannot be over-estimated. It is, in fact, so important that most makers fit ignition plugs in duplicate, and some Thyssen engines seen by the writer at Zollverin Colliery, at Catenberg, were fitted with ignition in triplicate.

(3)—Incandescent matter in the combustion chamber generally takes the form of carbonised oil, tar, and such dust as is drawn from the atmosphere with the inlet air. The presence of sulphur in the gas will cause such dirt as accumulates to bind together and adhere to the cylinder walls. Asbestos joints, if allowed to project beyond the jointing faces into the cylinder, are apt to become incandescent, and are sufficient to cause pre-ignition. Over-heated ignition plugs are a common source of trouble, and in this connection the writer has experienced much difficulty with an 8-cylinder vertical tandem gas engine. This trouble has, it is hoped, been permanently cured by the adoption of Lodge ignition plugs, which are mica insulated.

(4)—The regularity and reliability of the ignition is dependent on the magneto. In the case of a high-tension magneto, with its distributor, a very small amount of carbon, dust, or dirt, is sufficient to short-circuit adjacent terminals, which would, of course, cause ignition to occur at an incorrect time. It is imperative that magnetos should be reliable and inflexibly connected to the timing shaft, as the slightest alteration of the setting of the magneto renders breakdown imminent.

◆

WRITING in the *Vulcan* recently, F. O. Beckett gives an interesting account of how a flywheel burst a few years ago in a works at Sheffield. It appears that the pin holding the valve to the spindle of the boiler stop valve had been replaced by a common 5-16-in. bolt, instead of a properly fitted pin, and owing to heavy vibration the nut worked off and the bolt fell out. The bolt, of course, soon found its way along the steam pipe and jammed in the double-beat throttle valve. The engine was direct-coupled to a rolling mill, and as soon as the load was taken off the governor became inoperative in consequence of the throttle valve being fouled. As soon as the engineer saw the speed of the engine increasing, he threw off the governor belt and tried to close the throttle by hand; failing in this, he ran to the boiler stop valves, but while closing No. 1 valve the flywheel burst and completely wrecked the engine. One piece of the rim went through the roof and struck the flange of the dome crown of one of the boilers, indented the plate, but fortunately, did no further damage. Another piece cleared the works, crossed the River Don, and buried itself—some say 6 ft. deep—at the door of a cottage from which a funeral procession was emerging, and fortunately, this piece also did not cause personal injury.

◆

INVESTIGATE some of the belts that have successfully operated for 20 years without being shortened. Find out how it has been done. Learn how the belts are aligned, laced, dressed, etc. Perhaps you will then realize that it pays to spend a dollar or two more per year for the best belt accessories and in the end save money that may run into hundreds or thousands.

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COAL SCARCITY IN CANADA

The scarcity of certain varieties of coal continues to be a matter of first importance, not only in regard to the supplies for shipping, but relative to the requirements of manufacturing establishments as well. That there will be no coal in the country by March 15, 1917, is the forecast of one official. The Dominion Coal Co. reported some time ago that it was bunkering large supplies of coal for use on Government transports in anticipation of an acute famine on the St. Lawrence route, and recent developments in widely separated quarters continue to emphasize the seriousness of the situation in its every aspect.

In Eastern Canada, manufacturing and power plant institutions are very largely dependent for the supply of bituminous coal for steam raising and other purposes on the output of the mines in Cape Breton, and while at first sight the lack of available "bottoms" which is generally known to exist contributes in part to the decreased and decreasing receipts by consumers, other influences have been and are at work, the effects of which are still more far-reaching. In a word, production has been declining each month during the present year; shortage of men is the sole reason for the falling production, and enlistment for overseas service may be accepted as the sole reason for the labor shortage. During the year 1915, from January 1, until September 30, the output of the Dominion Coal Co. collieries at Cape Breton showed a steady increase from 287,000 tons in the former month to 452,000 tons in the latter month, or a grand total for the nine months of that year of 3,666,000 tons. In January of the present year the output amounted to 407,000, this total being maintained very approximately up until the end of March. In April the output fell to 378,000 tons rallying slightly in May to 383,000 tons since when there has been a steady decrease, the figures for September being around 345,000 tons. Should the rate of decrease continue, and there is little hope of its being arrested, the output for this year will show a falling off of probably three-quarters of a million tons.

In conversation with a gentleman in close touch with coal production elsewhere as well as here in Canada, we learn that instead of a decreased output being allowed to materialize abroad, special efforts have been put forth to intensify production, the various Governments concerned realizing as Canada's has not, that coal and especially bituminous coal is the basic munition in the war in which we are engaged. As if, however, ill-directed enlistment had not been sufficiently effective to restrict production, we understand that some 1,800 men left the Maritime Provinces in August to harvest in the West, the half of whom were taken from the mines and munition plants of Nova Scotia. A majority, if not all of those men were carried all or part of the way West on our Government Railroad, and of course at a low and attractive rate. Taken in conjunction with the lack of regulation of enlistments, it is plainly evident that the importance of coal for our manufacturing and power plant requirements is still unrealized by responsible Government.

In our present issue, boiler room efficiency and the conservation of heat are given more than ordinary prominence, and whether in view of a threatened coal famine which it is hoped may be staved off, or the initiation of a campaign for boiler room betterment, the data given is such as to make direct appeal to both owner and operator.

A PROMISING DEVELOPMENT

The development of trade between the various colonies of the Empire should continue to increase after the war at a gratifying rate because of the similarity of product in demand in the various Dominions as distinct from the United Kingdom. Electrical material was one of the lines in which Britain showed to disadvantage in foreign and colonial trade. The disadvantage was the result of superior quality, conservative design, and occasional lack of salesmanship. The first of these is admirable withal, and worthy of all due emulation, but the necessity for giving people what they want, eliminates any argument in favor of unsuitable construction, while if the time and terms of the attempted sale are ill-judged, the inability to extend business is easily understood.

In the matter of electrical equipment manufacture, the Dominion is well favored, by circumstances in the past and conditions in the future. Such a simple matter as the type of lamp socket used in overseas trade is one slight instance of favorable circumstance. With the exception of the United Kingdom, the use of screw sockets is practically universal all over the world. Some British firms in the past have offered the bayonet type of socket and lost the business rather than make both types. Makers in this country are in the more fortunate position of finding their own article and the foreigner's almost identical.

Home Office requirements in Britain have evolved super-excellent apparatus which is not in such demand abroad because of the absence of similar restrictions, which, however desirable from the standpoint of safety and reliability, cannot compete commercially with the ordinary grades of material in common use. The similarity in conditions and requirements between our own country here and such new markets as are offered by Russia, Africa, Australia, etc., is bound to be a strong help in obtaining a fair portion of former enemy trade in electrical lines.

The Operators' Point of View

GAS LEAK AND AN OPEN TORCH.

By J. H. R.

THE old adage of looking for a gas leak with a lighted match, has often been related—not always by the unfortunate explorer,—but by those who desire to warn others against embarking on a like enterprise. The original source of this article, not being of the ordinary gas leaking variety, may be of interest to the readers.

Some few years ago in a small jobbing shop, a number of special design internal combustion engines were being constructed, and when completed, were subjected to the usual test. During the operation of testing one of these engines, the charge refused to explode. After turning the engine over several times without success, the caps were removed from one of the valve seats, to try and locate the cause of the trouble. The operator, who was an experienced hand on gas engines, stooped down to investigate, but being rather dark, he called for a light. The light, which was an open flame torch, was handed to him, and unthinkingly he placed the light to the valve opening . The result, like the cellar explorer, was a gentle explosion, which centered itself in the face of the torch bearer, causing some serious burns, and the loss of his eyebrows and moustache; the latter being the most serious of all, as he stated himself he had been seven years in raising it.

* * *

THE ENGINEER OF TO-DAY

By N. G. Near.

IMAGINE, if you can, a lawyer who does not subscribe for a law paper, or who has no law books in his office. He would be a "poor excuse" for a lawyer, indeed. It would soon become evident to everybody who knew him that he was not up-to-date. He could not work long on the knowledge he had gained while at college, or that he had gained in some other office. I know of no such lawyer. I doubt if there is one, especially one that could truthfully be "called" a lawyer.

Again, imagine a doctor who refused to subscribe for a doctor's journal. He may be a graduate of the best known medical school in the world, yet, if he lays down flat after finishing his course and refuses to learn more, it would not be long and he would be properly termed a "back number." The function of the medical journals, like the engineering journals, is to keep its readers informed along the lines of latest practice. "Kinks" are to be found in medical papers just as in our papers. The journal is the proper channel for up-to-dateness. The book and the library are for reference to precedence and good practice in days gone by. Journals and books are indispensable.

The same may be said for the teacher. Teachers of any profession should be intensely up-to-date. It is impossible for them to do too much reading and studying.

Contractors, architects, concrete specialists, textile men, coal miners, machinists—every trade worker, in fact—should subscribe for some paper or other in his field in order to keep from dragging along behind the times. The paper subscribed for and read should be the best. The best paper is the one that is not too high above the reader's head and that is not so elementary as to teach nothing new—the paper must be alive to the present.

The engineering profession is just as important as are any of the above. There are more "new things" in engineering than in other lines, and therefore more to read about. The steam turbine, for example, has made enormous strides. Inventions of engineers make possible such highly developed sensations as the aeroplanes which loop the loop and fly circles around birds, the submarine, the battleship, enormous guns, the automobile, the steam railroad, and all electrical contrivances. All of these great things have been achieved since Watt made coal usable in the form of power. Power has therefore been the greatest civilizing agency and is now more important than ever.

Every engineer, no matter what his position, should read. Keep up with the times. Don't be a man of yesterday, last week, last year, or last generation.

Read!

Then apply what you have learend.

WHY GAS ENGINE BELTS SHOULD BE OPERATED WITHOUT SLIP.

By "Woodworker."

FEW operators of gas engines are aware of the seriousness of belt slip. Belt slip costs money, and the money loss can be easily computed if you know just how much the belt slips, and the amount of money you are paying per year for fuel. For instance, measure the diameters of your driving and driven pulleys (from center to center of belt) and compute the exact number of revolutions that the driven pulley should make. If it makes only 90 per cent. as many revolutions per minute as it should make, the slip may be computed as 10 per cent. 10 per cent. slip means 10 per cent. power loss, 10 per cent. fuel loss, and consequently 10 per cent. money loss. Each per cent. of slip means one per cent. money lost.

It is therefore clear that you should not permit slip at all. Just at the time of explosion there often is a little that cannot be avoided, especially on engines are provided with small or light flywheels. With larger flywheels, where fluctuation is reduced to the minimum, there is less danger of slip and often none at all. But in any case it is a good plan to measure your pulleys and make the above computation, and if your pulleys are slipping 5 per cent.; if you are spending $500 per year for fuel; you may as well save ($500 x .05=$25) $25. per year through preventing slip by taking care of your belts and pulleys and preventing the wear that goes along with slip. Sometimes the cost of wear and tear is greater per year than the cost of slip. Both costs may be eliminated as well as not by giving the belts a little attention once a week or once a month.

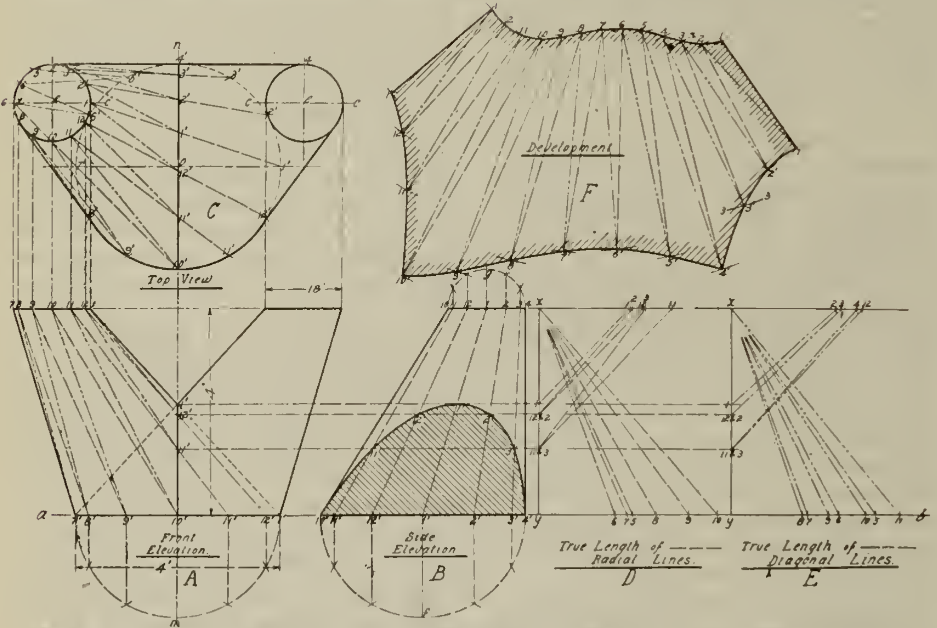
Also, don't run your belts too tight. It has been demonstrated that a tight belt may require 50 per cent. more power to be operated than a "slack" one. Besides, tight belts will not pull so great a load, they make bearings wear out more quickly, they require lacing oftener, and are more liable to break. It is well known that a slack belt will "live longer" than a tight one.

CONNECTING UPRIGHT MAIN TO TWO VERTICAL BRANCHES

By R. Hamilton.

A PIPE connection is required to unite two branches to the main supply pipe; all three pipes of circular cross section and in a vertical position. The main pipe is 4 feet in diameter, the two branches 1 foot 6 inches in diameter, with one side of the connection perpendicular with the base or large opening, and the projection of the pipes—as shown in the top view—tangent to one another, the altitude of the connection being 4 feet.

This problem with the accompanying solution illustrates an interesting example in triangular development. To obtain the three principal views necessary for the desired solution, proceed as follows:—First erect the perpendicular centre line mn, and from the point 0 describe a circle having a diameter of 4 feet; tangent to this circle at the point 4 draw the horizontal line 44^14. At a distance below this line, equal to the radius of the small branch pipe, draw the two horizontal lines ee and ee. With 0 as a centre and a radius equal to the radii of the large and small pipe, describe arcs cutting the lines ee at the point (e); with (e) as a centre, describe a circle representing the opening of the two branches, one on either side of the large circle. The top view can be completed by drawing the tangent lines connecting the three circles, and also the centre line representing the joint between the two halves of the connection, each of which are similar, but formed in the opposite directions. To obtain the front elevation, draw the base line ab and project the various points from the top view, cutting this base line and also the top line, which is drawn parallel to ab and at a height equal to the altitude of the piece; that is 4 feet. To the right of the front elevation, with a radius of 2 feet, and the point I as a centre, draw the semicircle 4^1f10^1 and divide it into six equal parts; from these points erect perpendicular lines cutting the base line as shown. From the point 4^1 draw the vertical 4^14, cutting the top line at the point 4; with 4 as a centre and with a radius equal to the radius of the small pipe, describe an arc cutting the top line at the point I; with the same radius and the point I as a centre describe the semicircle 4g10. Divide this semicircle into six equal parts, projecting the points down cutting the top line as shown. Now, from corresponding divisions in the large and small circles, in the top view, and also those in the front and side elevations, draw lines as shown. For instance, in the top view connect the points 1, 2, 3, etc., in the smaller circle with the points 1^1, 2^1, 3^1, etc., in the large circle; likewise in both elevations.



DEVELOPMENT OF CONNECTION BETWEEN UPRIGHT MAIN AND TWO VERTICAL BRANCHES.

In the side elevation it is necessary to obtain the true shape of the opening between the two connections. From the points 1^1, 12^1, 11^1 on the centre line mn in the front elevation draw the horizontal projecting lines cutting corresponding radial lines in the side elevation as shown. Through these points draw the curved line 10^1, 11^1, 12^1, 1^1, 2^1, 3^1, 4^1.

True Length of Construction Lines

Before proceeding with the development of the pattern, it is necessary to obtain the true length of both the radial lines and the diagonal lines. The radial lines are those connecting similar points of division on the upper and lower surfaces, and the diagonal lines are those connecting opposite ends of adjacent radial lines; for instance, the line joining the point 9^1 on the base line with the point 10 on the top line is termed a diagonal line, etc. To obtain the true length of a line that is at an oblique angle to both the horizontal and vertical planes, proceed as follows:—By using the projection to a vertical line, of a line in the elevation, as one leg of a right triangle, and the length of the line as represented in the plan or top view, as the other leg, the hypotenuse of such a triangle will be the true length of the line. Therefore, to obtain the true lengths of the radial lines for the development of the pattern, erect the vertical line xy as shown at D, the point (y) being on the base line and the point (x) on the projection of the top surface. With the exception of the lines that intersect the centre line mn, it is evident that the vertical leg of the right triangle will equal the length of the line 4, 4^1, as shown by the horizontal projection. The various lengths of the horizontal legs are obtained from the top view; thus, the distance y6 in D equals the length of the line, 6, 6^1 in the top view; the line y7 in D equals the line 7, 7^1 in C; the line y5 in D equals the line 5, 5^1 in C, etc. For those lines falling on the centre line mn, the vertical leg of the right triangle is obtained by projecting the points 1^1, 2^1, 3^1, 11^1, 12^1 in B to the vertical line xy, the horizontal leg being derived as previously stated, with the exception that the length is taken from the top circle to the centre line mn.

The true length of the diagonal lines is obtained in the same manner, the vertical leg of the triangle being the same, and the horizontal leg being the length of the line in the top view, passing from a certain division on the base circle to the adjacent division on the top surface. For instance, the distance y9 in E equals the length of the line 9^1, 10 in C, etc. The true lengths of the diagonal lines that intersect the radial lines cutting the centre line mn are found similar to that already described.

Pattern Development

To lay out the development on a flat surface, a start can be made from any point, but as a matter of convenience we will start with the line 4^1, 4, this being the only line whose true length is shown in the elevation. To distinguish the radial lines from the diagonal lines, the former are shown as a series of long dashes, while the diagonal lines are represented by long dashes, with two short dashes intervening. First draw the line 4^1, 4 in F equal to the corresponding line in the front elevation, then with 4 as a centre and the length 3, 4 in E as radius, describe the arc 3, 3 in F. With 4^1 as a centre and the distance 3^1, 4^1 on the irregular curve in B as a radius cut the arc 3, 3 in F at the point 3^1. Then with 3^1 as centre and 3, 3 in D as radius describe the arc x, x, and with 4 as a centre and one of the divisions on the small circle in the top view as a radius, cut the are x, x in F at the point 3. The completion of the development can be easily understood from the above explanation, care being exercised in following the method described. Remember that when using the points 1, 2, 3, 4, etc., as centres, the radii will be the diagonal lines as found in E, and the distances represented by the divisions on the smaller or top circle. When using the points 1^1, 2^1, 3^1, 4^1, etc., as centres, the radii will be the radial lines as found in D, or the distances represented by the divisions on the larger base circle, or that shown on the irregular curve in B.

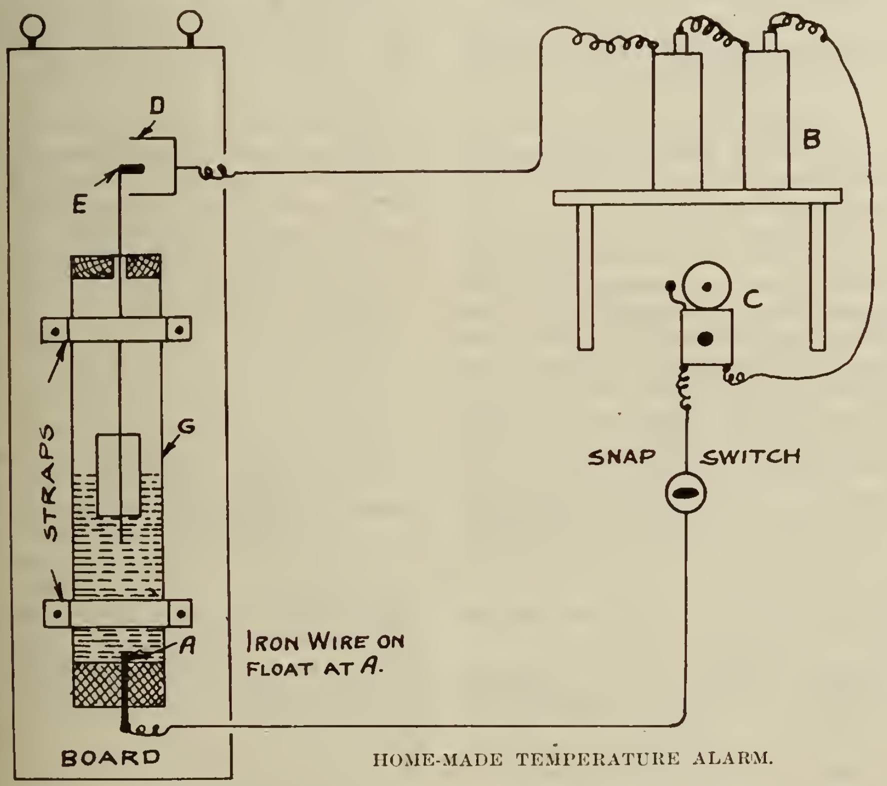
The foregoing constitutes the reply to a reader's query.

HOME-MADE TEMPERATURE ALARM

By J. E. N.

THE engineer in a large apartment house was continually annoyed by one of the tenants who claimed that the temperature of his rooms dropped to about freezing point during the night. By way of getting even with the complainant, the home-made temperature alarm described and illustrated was installed. A mercury tube was placed in the particular apartment, out of sight and during the tenants absence, and the bell was installed when the engineer could reach both it and the switch. At intervals during the night the apparatus was tested, and as it was set so that the bell would ring at a temperature of 70 degs. Fah., no legitimate "kick" could be made when it did so. It was found that the temperature never dropped below 70 degs. Fah. Several days elapsed on each of which the usual complaint was registered. A demonstration followed, since when the tenant has been silent.

The alarm apparatus costing about a dollar can be put together as follows:—Secure a piece of glass tube several inches long, as at G; run a piece of iron wire up into the tube from the bottom and close the end with sealing wax as at A. Iron wire must be used as mercury will dissolve copper or brass. Put some mercury into the tube. Make a float of sealing wax and attach a thin piece of iron wire to it with one end projecting through the bottom side of the float, the top of the wire being bent as shown at E. A piece of cork with a hole in it can be inserted in the top of the tube to act as a guide for the float wire. Attach the regular bell outfit as shown with a double point at D. The outfit can be used in bedrooms or elsewhere, the points at D being bent apart to suit temperature requirements. The bell will ring if the temperature rises or lowers abnormally, following which attention is directed and the trouble reminded.

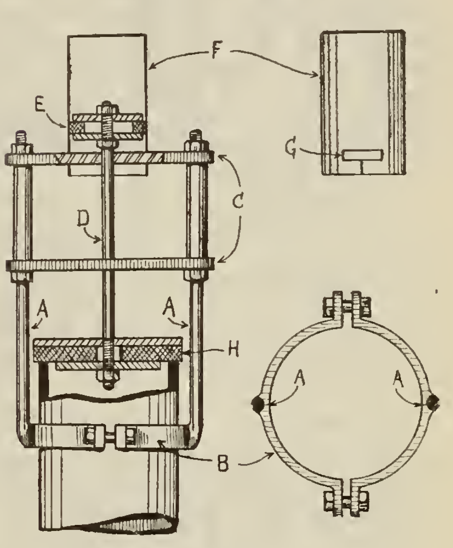


HOME-MADE TEMPERATURE ALARM.

EXHAUST RELIEF VALVE

By W. D. B.

THE relief valve shown in sketch is fitted to a 4 in. outside exhaust pipe. Two rods A, are welded to the clamping ring B, and are threaded on their upper ends for a length sufficient to allow two distance-pieces of pipe to be clamped between guide-bars C, by nuts top and bottom. Valve rod D passes through the guide-bars and is threaded at each end. A circular plate slightly larger than the pipe, is screwed on the lower end and a soft rubber condenser valve H is held in place below it by a nut and large washer. On the upper end a ring of ½ in. square packing E is clamped between two plates by nuts on the rod, and forms an easy fitting piston in dash pot F which is made of a tin can. A rectangular slot G on opposite sides of the can F fits on the upper guide-bar C, the lower side of the slots being cut down to the edge of the can so that it may be turned back to allow the can to be placed on the bar, where it is held in position by closing the edges in again. Packing E must be loose enough to allow the valve to drop of its own weight.



RELIEF VALVE FOR EXHAUST PIPE.

SMALL LOW VOLTAGE TRANSFORMERS FOR ELECTRIC BELLS AND SIGNALLING

By S. Rose.

SMALL transformers with low-voltage secondaries are now largely used for operating electric bells and signalling devices, and where alternating current is available they are much more satisfactory than batteries, as they require no attention. The secondary voltage being low, namely, 6 or 8 volts, ordinary bell wiring is sufficiently insulated for the service. There is here given the design for such a transformer to work on an alternating current supply of 110 volts, 25 and 60 cycles, the capacity being about 50 watts, with a secondary voltage of 6 volts. The core should have the dimensions as shown in Fig. 1, and be cut from thin sheet iron or sheet steel of good quality. The pieces should be cut in different lengths; for example, referring to Fig. 2, cut half of the sheets 7 in. long by 1½ in. wide, and half 4 in. long by 1½ in. wide for the limbs of the core, and half of 6 in. long by 1½ in. wide, and half 3 in. long by 1½ in. wide for the yoke. The pieces should then be painted with hot shellac or other insulating paint to reduce the eddy current loss in the core. Assembly should next be made with alternate strips, long and short, until 1½ in. square, or 2.25 sq. inches in area, is reamed. One yoke and two limbs can be assembled, and the coils slipped on, as shown in Fig. 3.

The number of turns in the primary winding for 110 volts, 25 cycles, is determined by the formula $\text{Tp.} = \dfrac{\text{Ep.} \times 10^8}{4.44 \times \ddagger \times \text{f}}$, where Tp is the primary turns, Ep the voltage primary, ‡ the magnetic flux, and

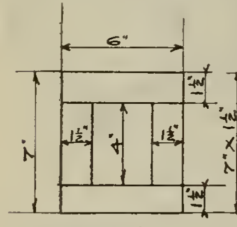


Fig. 1.

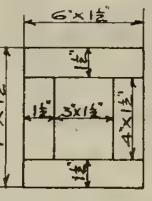


Fig. 2.

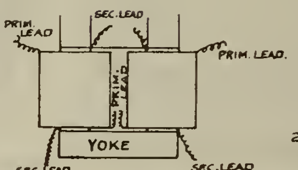


Fig. 3

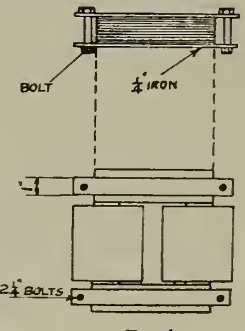
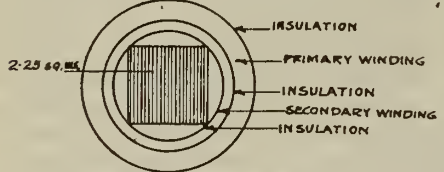


Fig. 4.



SECTION THROUGH CORE AND COIL

SMALL LOW VOLTAGE TRANSFORMERS FOR ELECTRIC BELLS AND SIGNALLING.

f the frequency. Allowing a magnetic flux of 65,000 lines, the number of primary turns $= \dfrac{110 \times 10^8}{4.44 \times 65{,}000 \times 25} = 1{,}524$ turns. The number of turns on the secondary is determined by the formula $\text{Ts} = \dfrac{\text{Es}}{\text{Ep}} \times \text{Tp}$, where Es is the secondary voltage. The number of secondary turns then $= \dfrac{6}{110} \times 1{,}524 = 82$ turns. In practice it would be better to use a greater number of turns than the formula calls for, because the supply voltage is often lower than 110 volts, and it would be quite noticeable in a transformer of this size and service. The secondary turns will be taken, therefore, at 90 instead of 82, as figured by the formula. The primary current is determined by the formula $\text{Ip} = \dfrac{\text{Watts}}{\text{primary voltage}}$ therefore the primary current $= \dfrac{50}{110} =$ .45 ampere, and the secondary current Is will be $.45 \times \dfrac{110}{6} = 8.2$ amperes.

The next thing is to determine the size of wire for the primary and secondary to carry the current without heating. Allowing 1,400 cir. mils per ampere, the size of wire for the primary will be No. 22, and the size for the secondary will be No. 12. The secondary winding is placed on the limbs first, and consists of 90 turns, 45 on each limb. The coils should be covered with two layers of oiled cambric or other material to insure good insulation from the primary winding which is wound over it. The primary winding consists of 1,524 turns of No. 22 D.C. wire, or 762 turns upon each limb over the secondary winding. The coils are wound in this way to prevent excessive magnetic leakage, which would result if the primary winding were placed upon one limb and the secondary upon the other.

The winding being completed, the other yoke can be assembled, and both yokes clamped as shown in Fig. 4. The two sections of the primary and secondary winding are connected in series, care being taken not to connect them so that the two halves oppose each other. At the point where the secondary sections join, a tap may be made and half voltage obtained if so desired. If the transformer is to be used on 60-cycle supply, the windings employed contain a smaller number of turns, as seen by the formula

$$\text{Tp} = \frac{\text{Ep} \times 10^8}{4.44 \times \ddagger \times \text{f}},$$

because as the frequency increases, the flux decreases; therefore, the number of primary turns for 60 cycles is $\dfrac{25}{60} \times 1{,}524 = 624$, and the number of secondary turns, Ts $= \dfrac{6}{110} \times \text{Tp} = \text{Ts} = \dfrac{6}{110} \times 624 = 34$ turns. Each limb in consequence will be wound with 17 turns of No. 12 wire for the secondary, and 312 turns of No 22 D.C. wire for the primary.

The loses in the transformer core will be small, and can be neglected if a good quality of very thin sheet iron or steel be used, and if each strip is well painted with a good insulating varnish or paint.

EXCESSIVE WATER CONSUMPTION

THE excessive water consumption in Canadian cities constitutes a very serious problem. The average daily consumption in the Dominion is 111 gallons per capita; in individual provinces it reaches as high as 143 gallons per capita, and in certain centres of fairly large size attains a maximum of 292 gallons. There is no doubt that these figures can easily be lowered. The consumption in Great Britain is below 25 gallons in several cases, and the highest rate is only 70 gallons per capita.

That the more extensive use of meters would remedy conditions to a great extent is shown by two of our prairie provinces, Manitoba and Saskatchewan, where meters are more widely used than elsewhere, and where the average consumption falls to 50 gallons and 55 gallons, respectively,—less than half the average for the remaining provinces. Nor would the introduction of meters mean an increased cost to consumers. The average estimated cost of water for Canada is 10.9 cents per 1,000 gallons, only provinces materially exceeding this being the two prairie provinces, where meter rates have already been widely adopted.

The rates charged on the meter basis could be adjusted to meet different local conditions, so that the amount paid by each consumer would be practically the same as at present, but all wastes would be avoided. Many Canadian municipalities have both flat and meter rates in force, the consumer having the choice between the two, but as a rule the meter rates are so ridiculously high for the average consumer that there is in reality no choice. For instance, although the estimated cost for Canada is 10.9 cents per 1,000 gallons, numerous cities and towns charge 30 cents and over, with several charging even over $1.00 per 1,000 gallons. Our excessive consumption is not due to the liberal and beneficial use of water, but to the careless waste by a few consumers in each community. Meters will not affect the former but will very effectively check the latter.

⁂

To save time is not the same as being in a hurry. A scamped job is never a time saver, but always the reverse. Have plenty of lifting appliances of an adequate nature for the job of repairing or overhauling an engine, but never try to save time in the cleaning of small parts or adjusting to a nicety working details. Much time is lost in an engine room by lack of a beam and tackle, or even by the erection of such when really it should form a permanent feature of the installation, and be ready to hand for use at short notice.

Operators' Instruction Course

CONCERNING INDICATOR DIAGRAMS—II.

TO take a diagram, a blank card is stretched smoothly upon the paper drum, the ends being held by the spring clips. The driving cord is attached and so adjusted that the motion of the drum is central. The cock is opened to admit steam to the indicator till the parts have become heated, which will be after a half-dozen revolutions. On being shut off, the pencil or marking point is brought into contact with the paper, the stop screw is adjusted, and a fine clear line traced upon the card. This is the atmospheric line. The cock is then opened, and after two or three revolutions the pencil is again applied and the diagram taken. If it is desired to ascertain the condition of the valve adjustment, the pencil needs to be applied only while the engine is making one revolution, but to determine power, it should be applied a longer time, so as to obtain a number of diagrams superposed on the same card. The fluctuations in the admission of steam, produced by governors which do not regulate closely, are so common, that this course should always be followed to obtain average results. The diagram having been traced, and the cock shut, the pencil should be applied lightly to the paper to see that the position of the atmospheric line remains the same. If a new line is traced, it is evidence of error or derangement, and the operations should be repeated on a new card

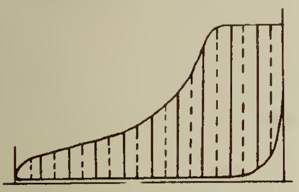


FIG. 2. DIAGRAM DIVIDED INTO TEN EQUAL PARTS AND HEIGHTS MEASURED MIDWAY BETWEEN EACH.

It is well to mark upon every card the date, time of day, and end of the cylinder from which it was taken. In adjusting the valves, the boiler pressure should be observed, and the changes that are made, before taking a diagram, noted on the card for reference. If a series of diagrams is being obtained for power, they should be numbered in order, and the number of revolutions per minute noted, either upon every card, or, if the speed is nearly constant, upon every other one. If tests are to be made for power used by machines or tenants, a number of diagrams should be obtained under each condition and the results averaged. It is well, in these cases, to mark each card of a set by some letter of the alphabet, and on the first of the set specify the machines at the time of operation.

Special Instructions

When accurate work is desired, too much care cannot be exercised in indicating an engine, and a further consideration of some of the points to be observed will aid the engineer in realizing their importance. Short steam connections of large bore from the cylinder to the indicator are desirable in all cases, and absolutely necessary with high speed engines. Avoid all turns, if possible.

The best cylinder oil only should be used for this purpose. The piston should be removed, and the cylinder and piston cleaned and oiled every half dozen diagrams. The oil contained in the steam is not sufficient in any case to lubricate the piston. A lack of lubrication will make a jumping action in the movement of the pencil, showing a series of steps, not waves, on the diagram.

On slow speed engines the lightest spring that will accommodate the pressure is best, but in high speed engines a heavier spring is necessary for the same pressure, in order to restrict the movement of the pencil bar and connections, and prevent their inertia from distorting the diagram. A waving line is the result of too great a movement of these parts.

The tension of the spring in the paper drum should in all cases be just sufficient to keep the cord tight; but this means that a greater tension must be used with high than with low speeds, to prevent the inertia of the drum overwinding itself and distorting the diagram; breakage of the cord also frequently results from this cause.

The tension of the cord is of no importance with slow running engines, but when indicating high speed engines it is desirable that the cord should always be kept taut, whether the paper drum is running or not. A good plan is to fasten one end of a rubber band to the driving cord four or five inches from the end, attach the other end of the band to the indicator just below the carrier pulley, so that it always keeps a tension on the driving cord. Make a loop in the end of this cord for hooking on the indicator, and the loose end admits of readily connecting and disconnecting without allowing the driving cord to become slack.

With slow speeds, a length of 4 in. to 4½ in. will show well proportioned diagrams, but as the speeds increase the diagrams must be shortened to avoid the effects of the inertia of the paper drum; and at very high speeds an instrument with a small paper drum should be used. Diagrams at very high speeds should not exceed 2 in. in length, and frequently 1½ in. will give better results.

The pressure of the pencil on the paper should be just sufficient to make a legible mark, and no more; a greater pressure creates friction and consequent inaccuracy in the diagram. Water in the indicator will make a curious but not a useful diagram, and therefore care should be exercised that the indicator is thoroughly heated up before a diagram is taken. Again, if much water is entrained in the steam, it will be necessary to leave the cylinder cocks slightly open while taking diagrams, as otherwise a distorted diagram is almost a certainty.

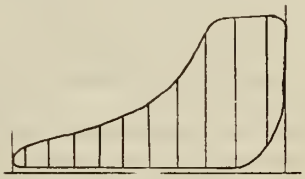


FIG. 3. DIAGRAM DIVIDED INTO NINE EQUAL AND TWO HALF PARTS, HEIGHTS BEING MEASURED ON CONTAINED DIVISION LINES.

When taking diagrams from steam engines, the height of the barometer or pressure of the atmosphere should always be carefully noted. This is necessary when the economy of the engines is to be considered, and it is desirable in all cases to know how much the exhaust pressure is above zero. Even at the sea level the pressure is constantly changing, and there are many engines working at places far above the sea level where the atmospheric pressure is always less, and in some cases very much less, than 14.7 lbs. per square inch, or 29.92 in. of mercury. Care should, therefore, be exercised in this respect, as there is a tendency amongst engineers to ignore this fact.

All gauges in ordinary use indicate pressures above the atmosphere if pressure gauges; or if vacuum gauges, the amount below atmospheric pressure; but neither kind shows the pressure above zero, or total pressure, and to arrive at this, the pressure of the atmosphere must be added to the gauge pressure in the first case, or the amount of vacuum subtracted from the atmospheric pressure in the second.

Computing Horse-power from Diagram

The work done by the steam in the cylinder of an engine is measured by the product of the force exerted on the piston, into the distance through which the piston moves, and is usually expressed by the term foot-pounds. If, for example, a force of 33 lbs. per square inch on a piston having an area of 100 square inches is employed to drive the piston 100 times over a stroke of 4 feet, the work done by the steam amounts to 1,320,000 ft. lbs. The amount of horse-power which the steam develops is the foot-pounds of work done in a minute divided by 33,000. In the example given, the horse-power developed when 100 strokes are made per minute is 1,320,000 divided by 33,000, or 40 horse-power.

The force exerted upon the piston is given by the indicator diagram, but as it varies in amount at different points of the stroke, it is necessary to determine the equivalent force which, acting constantly, would produce the same result. This is done by computing from the diagram what is termed the mean effective pressure. The product of the mean effective pressure, expressed in pounds per square inch; the area of the cylinder, expressed in square inches; the length of the stroke, expressed in feet; and the number of strokes per minute, which is twice the number of revolutions per minute, gives the number of foot-pounds of work performed per minute. This result divided by 33,000, gives the amount of horse-power developed.

To compute from the diagram the mean effective pressure, two lines are drawn perpendicular to the atmospheric line, one at each end of the diagram and the intermediate space divided into 10 equal parts, with a perpendicular at each point of division. To secure these divisions a radial divider, as illustrated, is employed.

Radial Divider Use

Draw a line across the paper at each end of the diagram at right angles to the atmospheric line. Place the diagram on this board, having the line on the right hand of diagram over the right hand line of radial board, then shift the diagram up or down until the left hand line on same meets the left hand line on board, then touch in the ordinates; set the card upside down, and in the same way touch in the points at foot of card.

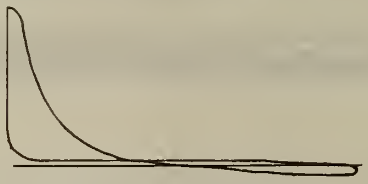


FIG. 4. LOOP DIAGRAM FROM NON-CONDENSING ENGINE CARRYING A LIGHT LOAD.

The determination of the mean effective pressure consists next in finding length of the various perpendicular lines found by the use of the radial divider. (Fig. 3.) This may be done by measuring each line with the scale and averaging the results. A better and quicker method is to employ a strip of paper, one of the cards upon which the diagram is traced if desired, and mark, one after another, the various distances on its edge, making thereby a mechanical addition, and requiring only a final measurement, and divide the value found by this final measurement by ten, which will give the mean effective pressure.

In non-condensing engines carrying a light load, the expansion line often extends below the back pressure line and forms a loop in the diagram, as is shown in Fig. 4. In computing the mean effective pressure in such cases, the distances below the back pressure line must be subtracted from those above the line.

PACKING TROUBLES

MUCH has been written on packings and their use says the *Dodge Idea.* It is the same with this as with other commodities, there are always engineers who experience trouble with any kind and any brand while others scarcely know what packing troubles are. That there is a reason, and a very important one, is self-evident. With some it is a good deal like the man who crosses a railroad without looking one way or the other — heedlessness, thoughtlessness. Every brand of packing carries its directions; and if these be disregarded it is probable some experimenting will have to be done if packing troubles are to be eliminated.

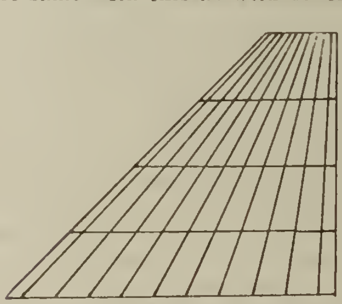


FIG. 5. RADIAL DIVIDER.

An engineer once bought what to him was a new kind of rod packing. He packed the piston rod of his engine every two weeks for four months before he read the directions. He then learned that he was putting some of the rings in "hind-side before," and the packing was blamed for all the trouble. The different styles of packing on the market are made with a view to obtaining certain results. These results can be obtained only when the packing is used as directed—on a rod in good condition and running true. Some engineers seem to think that directions accompany packing merely as a matter of form and that they know enough about packing to use it correctly without having recourse to instructions. Some do—and some do not.

LOSS OF POWER THROUGH FRICTION

A CAREFUL investigation and numerous tests establish the fact that the average loss of power due to friction is about 35 per cent. The smallest friction in a textile plant that the writer knows of is 29½ per cent., and the largest 52 per cent. It is a common experience to find friction loads of 40 to 42 per cent. Of course, this condition directly affects the cost record of operating, and recent tests also tend to prove that it affects the output materially.

This friction is not altogether due to belts. This includes all belts running on idlers, but the principal amount of this friction can be traced directly to the result of the present antiquated and insufficient method of aligning and leveling the shafting. It is a significant fact that more has been said on the subject of lubrication than on any other phase of the question, as if proper appreciation and application of the lubricant would entirely alleviate the difficulty. Lubrication does hold a large place, for the coefficient of friction with the surfaces efficiently lubricated is from one-sixth to one-tenth that for dry or scantily lubricated surfaces, but it is the pressure on the bearing that needs attention. Inaccurate alignment is almost wholly responsible for this excessive friction. A large corporation surveys and adjusts all shafting monthly, and states that it is a paying proposition. The chief engineer claims the tests show not only reduced friction, but improved quality of output. All shafting should be adjusted at least three times a year.

Question and Answer Section

Lacquer for Brass Plates and Pails.—I have a lot of brass plates and rails outside the building in which I am engineer, and find it impossible to keep them clean during the winter months. I want to know of a suitable lacquer also information as to its application, so that the weather effects be minimised or eliminated.—C.H.

There is no lacquer, varnish or other transparent coating which may be applied to the brass plates and rails while in their present position which would effect more than a temporary protection, as the application would necessarily have to be made by simple air drying method. If the plates and rails could be removed to a lacquering chamber and receive two or three applications of first grade celluloid lacquer or copal varnish baked hard in an oven, the results would be more satisfactory. The elements will eventually tarnish the brass in either case, and you will find the expense and trouble required to protect the brass does not warrant giving preference to the protective method rather than the usual procedure, such as cleaning at regular intervals with a fast cutting metal polish and subsequent application of a small amount of 3 in 1 oil. This oil acts as a protective and permits the brass to be quickly and easily polished the brass will remain bright for a longer period and does not become spotted as would be the case if lacquered. We advise the judicious use of 3 in 1 oil rather than the application of any lacquer of varnish.

* * *

Lute for Threaded Joints.—In our plant we have pipes carrying cold water, gas, air, steam, hot water and ammonia. It becomes necessary to remake joints occasionally, and, to enable me to deal intelligently with any of the foregoing, I should like to have advice as to a satisfactory lute to employ. Indicate at same time the joint treatment when oil and gasoline are carried in the pipes? M.I.

White lead, which consists of lead carbonate mixed with linseed oil, is the best lute for threaded pipe joints where water, gas and air pass through the pipes. Where they carry steam or hot water, red lead, litharge and linseed oil, mixed, should be used for making the joints tight. Where there is ammonia, oil or gasoline, water-glass is the best material.

* * *

Cracks In Iron Castings.—I should like to have some information on how to treat cracks in iron castings, the latter of course being understood to be those neither subject to internal pressure nor more than the slighted vibration, if any?—D. E.

Cracks often occur in iron castings, which, if not too serious, can be effectively repaired by driving into them a compound consisting of eighty parts clean iron filings, two parts muriate of ammonia and one part powdered sulphur, mixed together with a small amount of water. The compound sets rapidly and should be used as soon as made.

* * *

Paint for Power Plant Equipment.—Without reference to display, and altogether for preservative purposes and the maintenance of a clear tidy appearance, can you suggest a satisfactory paint for application to machinery generally, boilers, boiler piping, steel plate smokestacks, furnace doors and fronts, etc.?—M.R.

Machinery, boilers, boiler pipes, smoke-stacks and furnace doors can be satisfactorily painted with asphalt paint or varnish. Another paint of similar nature can be made by mixing ground graphite with coal tar. Where economy is the keynote, black (petroleum) oil is adapted to the foregoing purposes as well as to painting wood work. This oil makes an efficient coating, but has a disadvantage of accumulating dust and dirt to some extent, as it requires several months to thoroughly dry. The most efficient paint for steam pipes is a mixture of lampblack and boiled linseed oil. Paint for iron-girders, beams and similar work can be made by mixing iron oxide or litharge with boiled linseed oil. Asphalt paint is also very efficient for this work, but is objectionable on account of its light-absorbing properties, being black.

* * *

Hydraulic Jack Capacity.—A hydraulic jack has a ram 2 inches in diameter and a plunger ½-inch in diameter. It is operated by a lever 30 inches long, pivoted at the end, and applied to the plunger two inches from the fulcrum. If a man is capable of exerting 120 pounds on the lever, what load could he lift with the jack?—M.S.

A.—Area of ram is 2×2×.7854=3.1416 sq. in. Area of plunger is .5×.5×.7854=.19635 sq. in. Rotio of ram to plunger is $\frac{3.1416}{.19635} = 16$ to 1. Length of lever power arm is 30 inches. Length of work arm is 2 inches. Ratio of work to power is 15 to 1. Total ratio of work to power is 16×15=240 to 1. If 120 pounds be applied to the lever, the load lifted will be 120×240=28,800 pounds, or 14.4 tons.

* * *

Centrifugal Force.—What is understood by the expression, "Centrifugal Force"; in what manner or direction is it exerted, and by means of what formulae are calculations made in which machinery in motion comes under its influence?—W. L.

Centrifugal Force is the force which tends to move a body away from the centre about which it rotates. It is caused by the tendency of a body to move in a straight line rather than in a circle.

The formula for centrifugal force is

$$F = \frac{mv^2}{R}$$

In which m = the mass of the revolving body.

v = the velocity of its centre of gravity in feet per second.

R = radius = the distance between the centre of gravity of the body and the centre of motion.

For pulleys and other parts of machinery, this formula is best simplified so that we can use r.p.m. instead of ft. per sec., and weight in pounds instead of mass.

$$m = \text{mass} = \frac{W}{g}$$

where W = total weight of body in pounds.

g = value of the force of gravity = 32.16.

$$N = \frac{60v}{2 \times 3.1416 \times R},$$

Steam Power Plant Auxiliaries

STEAM TRAPS—III.

THE great majority of steam traps are more or less dependent on one particular principle as a basis for their operation, each arrangement being designed to accomplish one or more specific purpose—thus, one trap may have an inherently large bore of valve seat, another may be suitable for a wide range of pressures, and another may be so constructed as to avoid any possibility of air binding, while in addition to the foregoing, accessibility for repair and ease of replacement are additional features striven after by others.

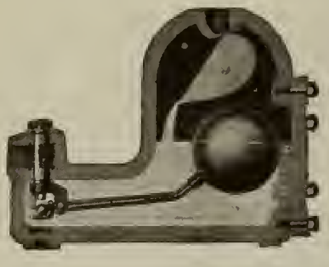


FIG. 12.—NASON-VESUVIUS STEAM TRAP WITH FLOAT ACTUATED BALL VALVE AND TILTING BUCKET

Nason-Vesuvius Steam Trap

In this trap every effort has been made to embody such features as are desirable or necessary to satisfactory service, while a novel device is provided to insure freedom of flow and certainty of valve action. The Nason-Vesuvius trap is of the intermittent discharge, float control type, having a regrinding ball valve which is either full open or closed, and also a self-tipping bucket designed to facilitate the controlling action of the float. The interior of the trap is shown in Fig. 12, which illustrates the principal features of construction.

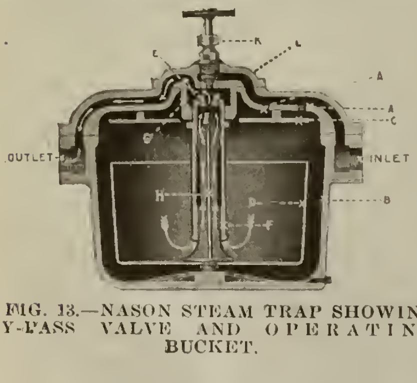


FIG. 13.—NASON STEAM TRAP SHOWING BY-PASS VALVE AND OPERATING BUCKET.

When the trap is being installed, it is placed at the lowest point to be drained, connection being made at the inlet, while the outlet, which is closed by a ball valve, is piped in any convenient manner. The incoming water is received in a copper tilting bucket, which is so balanced that it tips over when filled, the contained water falling into the main body of water below. The action of this falling water imparts a quick upward impulse to the float, which pulls the ball downward from its seat, allowing a clear free way for the discharge. The contents are now discharged until the receding water level allows the float to drop, thus raising the ball valve back towards its seat, until a predetermined level is reached when the flow of the discharge picks up the ball and instantly seats it, thus closing the orifice until such time as additional drain water causes the operation to be repeated.

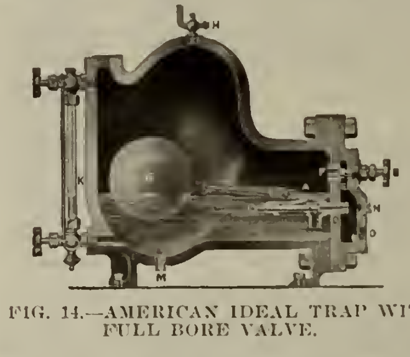


FIG. 14.—AMERICAN IDEAL TRAP WITH FULL BORE VALVE.

Normally, this trap is of the intermittent type, but, under overload conditions, the discharge becomes continuous until the excess of condensation is removed, when its normal intermittent operation is resumed. It possesses the one advantage of a continuous discharge trap in its ability to take care of excess condensation, and none of its disadvantages, for the reason that the valve is either fully open, or tightly closed, thereby preventing scoring of the valve seat. A feature that greatly prolongs the life of the seating surfaces is the peculiar action of the ball valve construction, which results in a different portion of the ball surface being presented to the seat at each closure. The fall of water from the tilting bucket keeps in motion any particles of scale or foreign matter, so that they do not settle, but are discharged with the water, which seals the valve at all times.

This trap is built by the Nason Mfg. Co., New York, in three classes, suitable for pressures from 1 to 50, 50 to 150, and 150 to 250 lbs. per sq. in. Four sizes in each class are made, with pipe connections from ¾ in. to 2 in. Examination or repair is easily accomplished without disturbing the pipe line connections; by removing the cover and loosening the valve plug the working parts are instantly removed from the body.

Nason Steam Traps

A trap of the bucket type is made by the above mentioned firm, and is adapted for pressures from 1 to 20, 20 to 70, and 40 to 150 lbs. per sq. in. The type of construction common to each is shown in Fig. 13. A cast iron reservoir or pot B, closed with a cover G provided with two cored passages, contains an open float D, which is fitted with a ribbed spindle H for its guidance. A housing or sleeve F is screwed centrally into the under side of the cover G, and within it the spindle H slides smoothly, permitting a short vertical motion. The top of the spindle is ground flat, and its upward movement is arrested by coming in contact with the bronze plug E, having a central opening, the two surfaces thus constituting a discharge valve for these traps. One of the cored passages in the cover alluded to is for the discharge of water from the trap after passing through the valve E, and the other serves as a by-pass, to permit any large volume of air or water to be blown through, when starting, without going through

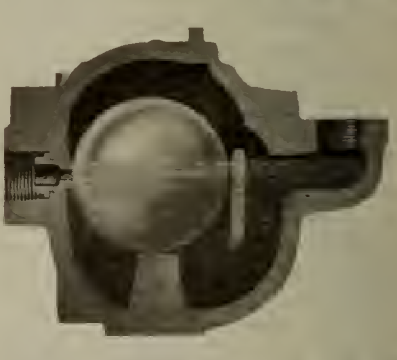


FIG. 15. — SECTIONAL VIEW OF THE JOHNS-MANVILLE STEAM TRAP SHOWING CONTROL BALL AND VALVE SEAT

the discharge valve. Valve K gives entire control of this action.

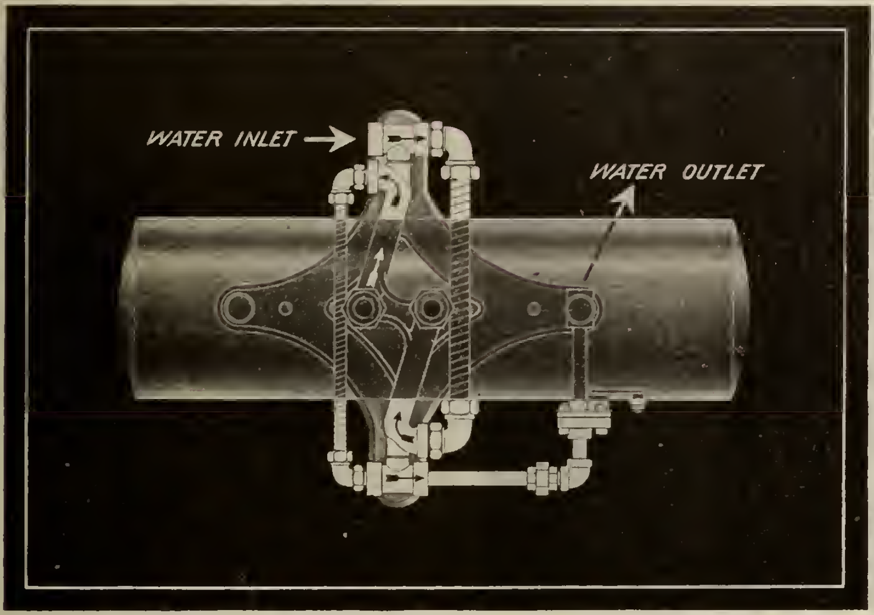


FIG. 16.—FARNSWORTH NON-RETURN SEPARATING TRAP.

The trap being so placed that the water of condensation flows into it by gravity, the discharge enters at the point marked "Inlet" and passing through the cored openings AA into the body of the trap B, a diaphragm C above the float D diverts the water of condensation into the pot or body of the trap B, where, gradually rising, it raises the float D, thereby closing the discharge valve E. Valve K being closed, discharge from the trap is shut off and remains so until the float D becomes nearly filled from the overflow of water into it, when its weight becomes such that it overcomes the tendency of the discharge valve E to remain closed, being held there by steam pressure, and it drops to the bottom, thereby opening the discharge valve E. Acting on the surface of the water, the steam pressure immediately drives it up through the sleeve F (as indicated by arrows), through the discharge valve E, and thence by way of the cored passage to the "Outlet."

When the float D has been nearly emptied it becomes so light that it is again raised by the water surrounding it, thus closing the discharge valve E, and the operation is repeated. The weight of the float D is such that a permanent water seal always remains over the point of discharge into the sleeve F, thus preventing escape of live steam where the discharge valve E is open.

From the above description it will be observed that the valve action is purposely intermittent, which necessitates that it shall be either wide open or completely closed, an advantage which entirely obviates any tendency to wire-drawing. The life of the valve is thus definitely prolonged and danger of leakage at this point reduced to a minimum.

American Ideal Steam Trap

This trap is of the float-controlled, water-sealed, full-bore valve type, the controlling float operating the valve through a powerful toggle mechanism, as shown in Fig. 14. Sediment blow-off, air cock and water gauge are provided, also a by-pass valve connecting the interior of the trap with the outlet connection. Six sizes are built by the American Steam Gauge and Valve Mfg. Co., Boston, the pipe connections ranging from ⅜ in. to 1½ in., and the capacity of water in lbs. per hour at 100 lbs. pressure, from 2,756 to 42,700.

Johns-Manville Trap

As an example of extreme simplicity, this trap is interesting. It comprises a body, rolling ball, and discharge bushing, and the ball is the only movable part of the complete device. The non-attached rolling ball is subjected to a pressure equal at all points except that area resting against the discharge orifice. When condensation enters the trap through the inlet (see cross section, Fig. 15), the ball rolls up, exposing the discharge opening, which permits a discharge of water and air without any loss of steam.

A feature of the trap is its inability to air-bind, because the air, being heavier than steam and lighter than water, forms a film on the surface of the water and is carried out with it. While the condensation acts as a lifting force, which is responsible for the outlet being uncovered, allowing the escape of water, air, and other gases, the steam pressure simultaneously forces the ball to seat itself against the upper part of the opening with sufficient pressure to prevent any possible discharge of steam The ball readjusts itself to its seat automatically every time the trap discharges, and is thus kept clean. The H. W. Johns-Manville Co., New York, are the makers of this trap.

* * *

Earnsworth Tilting Traps

A series of tilting traps adapted for a variety of service is shown in Figs. 16 to 19. These are the product of the Farnsworth Mfg. Co., Boston, and are marketed by the Canadian Fairbanks-Morse Co. Various types of the Farnsworth tilting trap are shown in Figs. 16 to 18, while a duplex boiler feeder is shown in Fig. 19.

The principal features of this trap are the substitution of knife-edge trunnions in place of packed trunnions, the incorporation of Everlasting blow-off valves as a standard component of the apparatus, with positive valve control, entire control of operation by the condensation, and a complete absence of

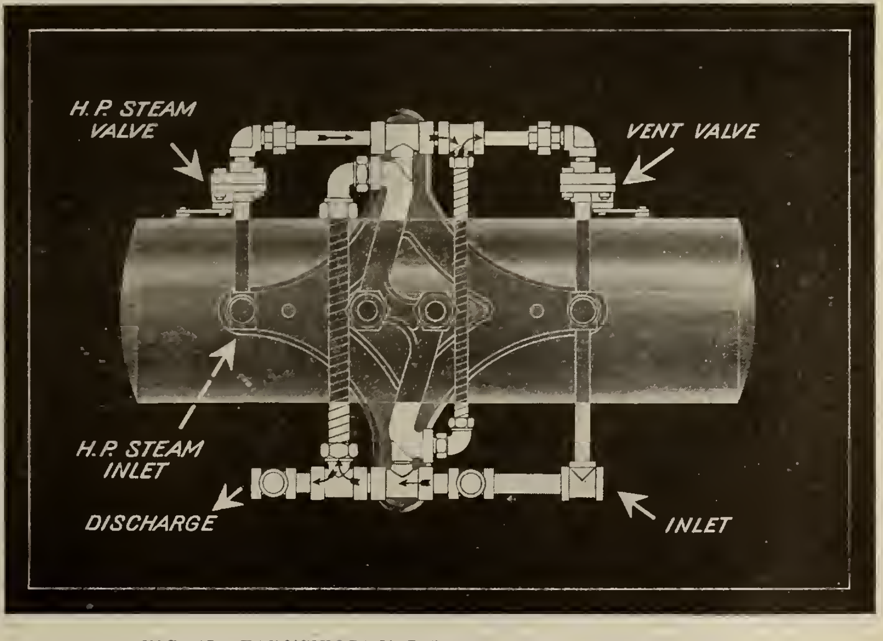


FIG. 17.—FARNSWORTH LIFTING OR PUMPING TRAP.

packing or lubrication. The tanks used are of welded construction and suited for a working pressure of 125 lbs. per sq. in. By providing knife edges on which to oscillate, the trouble due to binding and leaking of packed trunnions are eliminated, while the oscillation of the tank is utilized as a positive means of operating the blow-off valve.

When starting the trap, the short end is held down to allow the tank to be filled by condensation—once being sufficient for any length of service. On being released, the long end tilts down, opening the outlet valve and allowing the trap to discharge until the long end is drained through a diagonal pipe into the short end, thence out through the discharge valve. The tank then oscillates, the short end tilting down, closing the outlet valve and allowing condensation to again accumulate in the long end. This procedure continues until the pipe line is completely drained, the steam being water-sealed and not allowed to escape during the operation of the apparatus.

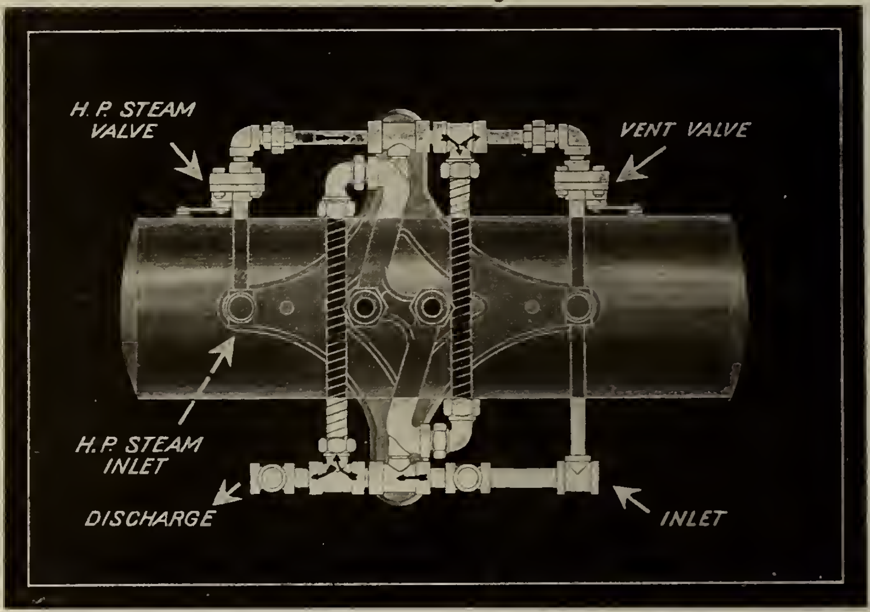


FIG. 18.—FARNSWORTH DIRECT RETURN TRAP.

By an ingenious arrangement of additional valves, it is possible to produce various styles of traps, all of which employ the positive valve control. Fig. 16 shows a non-return separating trap which receives condensation under high or low pressure and delivers it approximately two feet upward for every pound pressure on the line being drained; this type of trap does not return the water to the boiler.

A lifting or pumping trap is shown in Fig. 17, which receives low pressure condensation and lifts or pumps it to any point of use (except into the boiler) by the admission of high pressure steam at the moment of discharge. This type may be used with economy as a steam pump for handling any liquids, and may be operated in a submerged condition as a bilge pump.

When it is required to deliver condensation directly into the boiler at higher temperatures than possible with a steam pump, the direct return trap, Fig. 18, may be used. This trap receives condensation at high or low pressure and automatically returns it to the boiler with a lower steam consumption than that of a pump, economy being effected by conserving the heat lost through pressure reduction and temperature radiation in other methods of boiler feeding.

An interior view of the Farnsworth duplex boiler feeder from the water side is shown in Fig. 19. This apparatus confines into one the hot well, air pump, vacuum devices, heater and boiler feed pumps. It is adapted for use with pressure and vacuum heating, and in the case of the latter creates and maintains the vacuum. Its construction is similar to the tilting traps, the tank oscillating on knife-edges and having the same valve operation, being, in fact, a duplex direct return trap. The tank is so made and adjusted that one side is always receiving while the other is always delivering directly into the boiler, resulting in continuous circulation and preventing the system becoming water-logged.

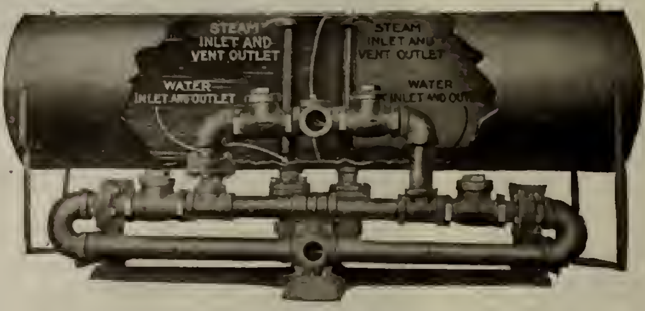


FIG. 19.—FARNSWORTH DUPLEX BOILER FEEDER. WATER SIDE.

* * *

CANADIAN SOCIETY OF CIVIL ENGINEERS

AN interesting meeting of the Toronto Branch of the Canadian Society of Civil Engineers was held in the rooms of the society at the Engineers' Club on Oct. 12, 1916. The subject for the evening was "The Quebec Bridge," and Messrs. Ambrose and Steenbuch, who observed the operations in connection with the recent attempt to place the central span, addressed the meeting. Mr. Steenbuch gave a short historical review of facts in connection with the bridge, and, by the aid of excellent slides, explained methods employed in the construction of the giant cantilever arms as well as that of the central span. Mr. Ambrose confined his remarks more particularly to the central span, the methods of floating it into place, and raising it. These operations were illustrated by many photographs taken by the speaker, and gave a clear idea of the immensity of the task. Both speakers laid particular emphasis on the thoroughness and foresight apparent to an observer with which every detail had been worked out.

Towards the close of the meeting a resolution was carried unanimously that the Toronto Branch convey to G. R. Duggan its sympathy and also its absolute conviction that success would crown the next effort to complete the bridge.

It was also resolved and unanimously carried that the Toronto Branch convey its hearty congratulations to Col. Mitchell, one of its most prominent members at present at the front, on his well-earned promotion to the posiion of first staff officer of the Second British Army in France.

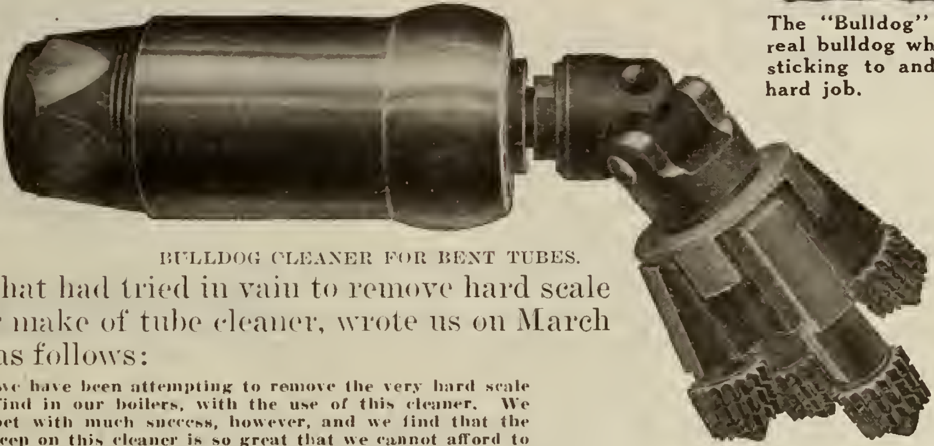
The matter of the Government employing alien engineers was also considered, and the following resolution carried:—"That the members of the Toronto Branch condemn the practice of any Government, Federal, Provincial or Municipal, employing alien engineers to the exclusion of Canadians competent to do the work; and, further, that a committee, consisting of G. A. McCarthy, chairman; L. M. Arkley, secretary-treasurer; Prof. Haultain and J. R. W. Ambrose, be appointed to consider this question at a joint meeting of the Canadian Manufacturers' Association, Toronto architects, and construction contractors.

Get A Bulldog

and remove scale the cheapest and fastest way

It is after you have put a Liberty "Bulldog" Tube Cleaner at work on an unusually long and tough job, that you appreciate what a **real thing** you have got in a Tube cleaner. No scale proposition too hard for the "Bulldog."

The "Bulldog" Cleaner is a real bulldog when it comes to sticking to and staying on a hard job.



BULLDOG CLEANER FOR BENT TUBES.

A company that had tried in vain to remove hard scale with another make of tube cleaner, wrote us on March 24th in part as follows:

> **"————we have been attempting to remove the very hard scale which we find in our boilers, with the use of this cleaner. We have not met with much success, however, and we find that the cost of upkeep on this cleaner is so great that we cannot afford to use it longer. The makers of this cleaner, themselves, recommended that we try your "Bulldog" Cleaner, saying that in their opinion it was the only cleaner on the market that would give us satisfaction————"**

In due time a "Bulldog" Cleaner was sent them and tried out.

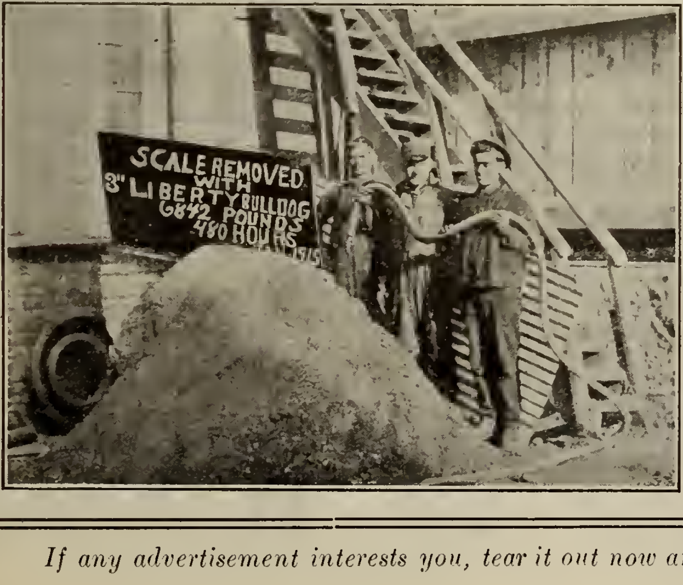
It gave satisfaction. It lived up to its reputation. It justified its name.

Catalog "H" describes both "Bulldog" and "Victor" Tube Cleaners. It is the one to send for. Mighty interesting to the man who wants to get rid of scale in the easiest and fastest way.

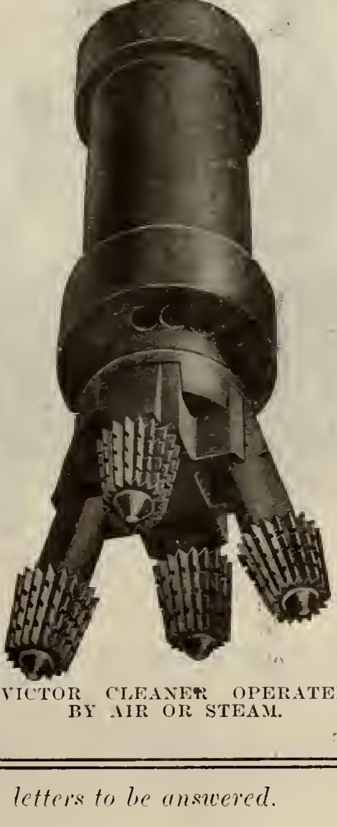
Liberty Manufacturing Co.

6904 Susquehanna Street Pittsburgh, Pa.

The illustration below shows the result of a 3-in. "Bulldog's" battle with scale. That 6,842-pound pile of scale was removed from four 450-hp. Stirling Boilers. The "Bulldog" ran continuously for 480 hours without any repairs except drill points.



Just as the "Bulldog" is the King of the water operated Tube Cleaners the "Victor" is the Premier of the Tube Cleaners operated by air or steam. The "Victor" (shown below) is made in all sizes suitable for all types of boilers.



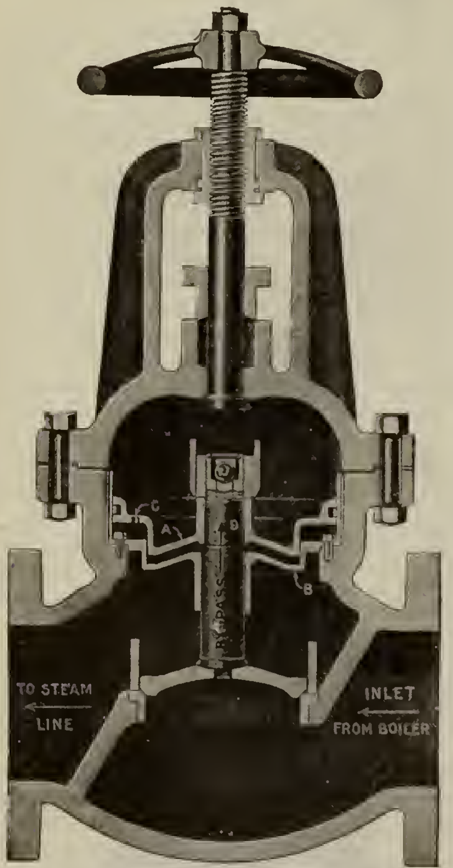
VICTOR CLEANER OPERATED BY AIR OR STEAM.

Progress in New Equipment

AUTOMATIC TRIPLE ACTING NON-RETURN VALVE FOR BOILERS.

NON-RETURN valves prevent the backward flow of steam into the boilers from the header in case of a rupture. The added emergency feature shown in the cuts also prevents an outward rush of steam should a break occur in the main steam line or branches. In a battery equipped with these valves the outflow from every boiler is stopped if anything happens to the header or main piping.

The sectional view shows the inside dash pot A attached to the valve disc, while the outside dashpot B acts as a cylinder, which is held firmly in place by cap bolts. The valve disc has a central port with a ball valve at the top and through this port full boiler pressure reaches the entire space above the liner and underneath the inside dashpot at C, therefore, it is balanced A pipe connection is made to the exhaust port in the side of the triple acting valve, which communicates with the space between the two dashpots, being piped to the pilot valve which also connects with the outlet side of the valve or header.



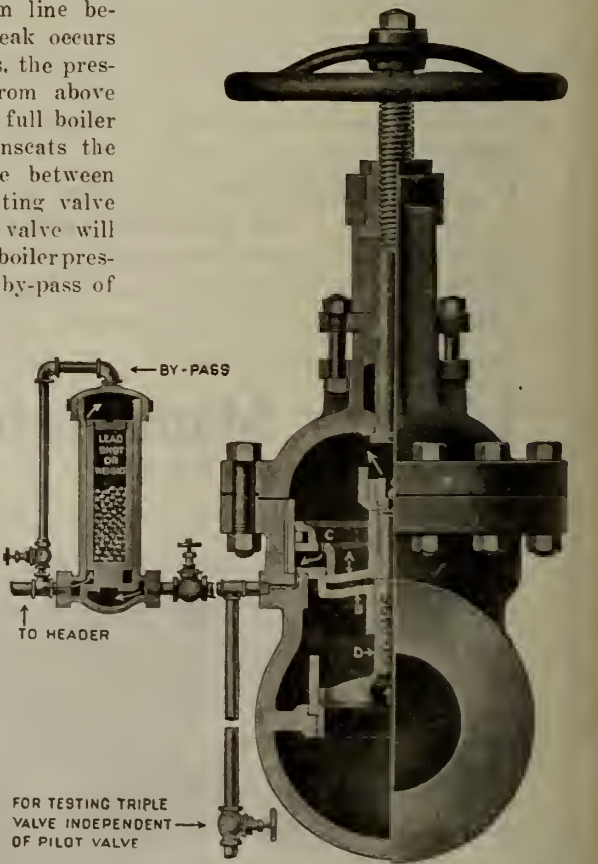
LONGITUDINAL SECTION AUTOMATIC TRIPLE-ACTING NON-RETURN VALVE.

The header pressure being on top of the piston of the pilot valve and the boiler pressure underneath, the weighted pilot valve piston, according to weight adjustment supplies the variation on which the triple acting valve will operate in case of a burst steam line beyond the valves. When a break occurs in the steam main or branches, the pressure is instantly removed from above the pilot valve piston and the full boiler pressure being underneath, unseats the piston, allowing the pressure between the dashpots of the triple acting valve to escape. The triple acting valve will immediately close, and the full boiler pressure still coming through the by-pass of the valve disc on top of dashpot A holds the valve to its seat, cutting off the flow of steam from the boilers.

Thorough cushioning of such valves is vitally necessary to eliminate disastrous hammering or pounding, and the Double Corliss Dash Pot arrangement, occupying the full area of the upper portion of the body, insures smooth, economic and reliable operation; holds the valve disc in perfect alignment with the seat, and makes the valve practically indestructible due to service. In the closure of the valves the double cushioned feature allows a quick drop to within 1/8 in. of the seat, then the valve closes easily under the control of the secondary dashpot. By turning the handwheel, the stem may be run down on top of the valve disc, thus making a permanent closure of the valve.

The triple acting valve may be closed or tested at any time independent of the pilot valve by having a small branch line run to any convenient point with a small hand valve attached, as illustrated. Upon opening the small valve and allowing the exhaust of pressure from between the dashpots of the triple acting valve, the latter will close—thus providing for all contingencies and insuring absolute safety in the operation of the plant. An automatic valve should be tested automatically to prove it operative to close in event of accident.

There is no adjustment to be made in the triple acting valve. The automatic pillot valve can be quickly set for any variation of pressure by simply adding or removing shot or other weight from the hollow piston for greater or less variation between the boiler and header pressure. The boiler



PART CROSS SECTION THROUGH AUTOMATIC TRIPLE ACTING NON-RETURN VALVE.

The Man Below Cannot Do It All

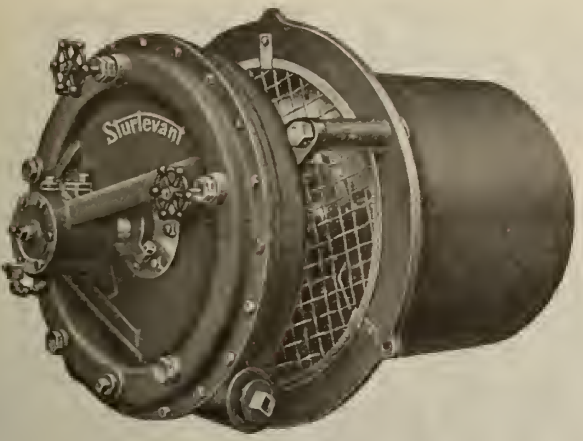
Do not blame the engineer and the fireman if you cannot get all the steam you want—if the pressure goes down—if steam cannot be gotten up in a hurry. It is not all their fault. Your boilers are overloaded, and to get the extra steam you should install a

Sturtevant
(REG. CAN. PAT. OFF.)

Turbo-Undergrate Blower

It will give you sufficient draft to get over peak load. Granted that you have decided upon some blower, why not a Sturtevant? Mechanically it is superior to any other. Take the bearings for instance. There are no ball bearings to rust, crack or give trouble, but instead there are generous bronze journals with oil-ring lubrication. The reservoirs are of ample capacity and will hold an oil supply that will last for several weeks.

Bulletin 214-U tells what the Sturtevant Blower will do. A copy is awaiting you.



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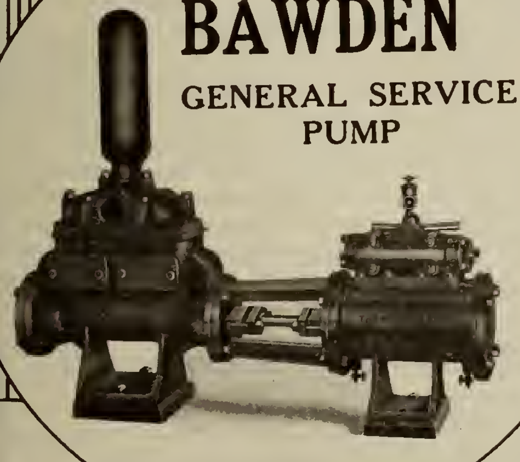

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The Steam Cylinders are designed to withstand modern pressures. They are fitted with cast iron block pistons, self-adjusting cast iron rings and steel rods. Water cylinders are of suitable strength for pressures not exceeding 100 lbs. per square inch.
Drop a card for full particulars.

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133 STERLING ROAD, TORONTO, CANADA

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914, With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID,
Minister of Public Works and Highways.

W. A. RIDDELL, M.A. Ph.D.,
Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

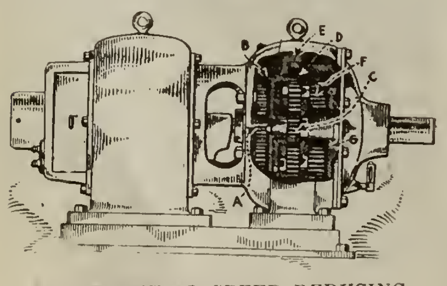
and header pressure can drop together from say 175 to 50 pounds without operating the valves, but, the instant the variation of pressure reaches that for which the automatic pilot valve is set, the valves will operate quickly—which is the only time you want them to operate. The Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., are the manufacturers of the foregoing.

DEVICE TO PREVENT MOTOR REVERSALS

TO guard against the serious results attendant upon alternating-current motor reversals, especially when the motors are installed in connection with elevators, hoists, conveyors, cranes, machine tools and textile machinery, the General Electric Co., Schenectady, N.Y., has developed a reverse phase relay. It operates on the same principle as a squirrel cage induction motor and is made in both circuit opening and circuit closing types. The interhanging of wires by power companies, as when repairs to cables are made, is a condition, for example, to be guarded against. The type of contacts required for any installation depends on the method of tripping out the motor switch. The operating coils of the relay correspond to the stator of an induction motor, while a hollow aluminum cylinder connected to the contacts corresponds to the rotor. The latter, however, does not rotate but moves either upward or down when one of the phases of the line is reversed. This movement causes the toggle to buckle and move the contacts.

DIFFERENTIAL SPEED REDUCING MECHANISM

THE Foote Bros. Gear & Machine Co., Chicago, has placed on the market a double differential speed reducing mechanism of the all spur gear type. This differs from the company's standard type which has been on the market for some time. In the new device the first part of the mechanism is non-planetary and the second set is planetary, which it is emphasized, eliminates the objection to the high speed planetary set of idlers that were fastened to a flat plate and rotated around the high-speed shaft. Another advantage claimed for this arrangement is the ability to get a considerable speed reduction in a small space compared with other devices.



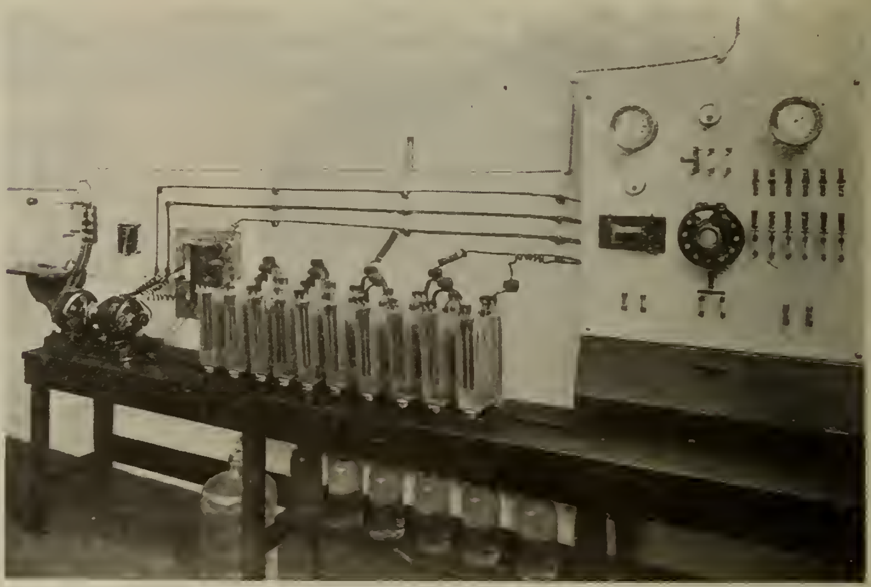
DIFFERENTIAL SPEED REDUCING MECHANISM.

The first king pinion A is keyed directly on the motor shaft, which eliminates the flexible coupling between the motor and the speed reducing mechanism and also enables the connection to be made much shorter by using a thimble. This thimble connection is counter-bored to go over the standard cover of the motor and forms a part of the front side of the reducer case. The first set of studs and idlers is rigidly fastened in the case and trasmits motion from the king pinion to the internal gear B that is partly journaled on the slow-speed shaft. This gear is also supported at its outer edge by the hub on the planetary cage carrying the planetary pinion. A pinion C is rigidly fastened to the hub of the internal gear which gives a planetary motion of the second set of idler pinions D. The outer periphery of these pinions meshes with the stationary rack E which is rigidly fastened in the case and gives the pinions a planetary motion around the king pinion. A shaft is introduced into these planetary pinions and supports another set of idler pinions F that mesh with the last gear G which rotates the slow-speed shaft.

It is explained that this arrangement makes it possible to get a very large reduction in the last two sets of gears by having slightly fewer teeth in the last internal gear G than in the stationary rack E. For example, if the last internal gear has 60 teeth and there are but 59 in the stationary rack, the ratio in this pair is 59 to 1 which when multiplied by 5 to 1, the ratio of the first redution gears, gives a total reduction of 295 to 1.

150 HOUR GROUP STORAGE BATTERY

THE accompanying illustration shows a very conveniently arranged 150-hour group storage battery with the necessary charging equipment and switchboard. This installation is for the exclusive operation of the clocks and bells at the Montreal High School, and takes care of 88 electric clocks, sixteen 16-inch fire gongs, and eight 10-inch call bells, located at various places throughout the building. The batteries are charged from a direct current generator, direct connected to a 1-5 h.p. alternating current motor. This installation is placed in a small room situated in the main building.



150-HOUR GROUP STORAGE BATTERY AT MONTREAL HIGH SCHOOL.

* * *

The practice of putting steam boilers into the hands of non-technically instructed people, either for installation, repair, or usage, is most reprehensible, as the risk incurred is great. It is not necessary for a boiler attendant to be an adept scientist or an engineer, or even a boilermaker as none of these is at all likely to have received any special training in this direction. The man to select as a boiler attendant or engineman should be sensible, steady, methodical, and inquisitive. He should have the qualities of a man who has a respectful fear of a gun, whether loaded or unloaded—a careful, intelligent person, with sufficient commonsense to act according to the instructions of those in charge of the plant, presuming, of course, that they are technically trained engineers.

* * *

Power costs money. Every additional horse-power that is required means more steam used, which in turn means more coal burned. If one horsepower can be saved throughout the year, a saving of approximately $40 00 will be made.

F-M Power House

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NO. 1 DEVOTED TO THE HIGHEST GRADE POWER EQUIPMENT OCT. 1916

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All styles and sizes for handling many different kinds of liquids, under diverse conditions.

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The many other different styles, centrifugal, triplex, rotary Fire Pumps, direct connected Outfits, Water Works Pumps, etc., are built in the most modern factories by men who have had the widest experience in pump manufacture. We will gladly send you catalogues of various pumps, on request.

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Fairbanks-Morse residence pumping and lighting outfits cover the entire range from the smallest hand pumps to the most elaborate systems, such as recently sold for the Sir William Van Horne Residence.

The New Combination Rubber and Steel Valves

The valve with a backbone

The steel plate gives such strength to the Valve that the highest pressure cannot warp, twist or in any way get it out of shape, while the rubber affords the proper seating qualities.

''Better than Metal because of the Rubber—Better than Rubber because of the Metal.''

It costs less because it lasts longer, and saves annoyance of replacements.

Guaranteed Power Equipment

On the following pages will be found some of the highest grade power house supplies and equipment which we particularly wish to call to your attention:

Palmetto Packing -	**Page 67**
Graton & Knight Belting -	**" 68**
"Penflex" Metal Hose -	**" 66**
Direct Separators -	**" 66**
Pratt & Cady Valves	**" 66**
American Steam Gauges and Valves	**66**

Some of the many offices and warehouses of
Canada's Departmental Home of Mechanical Goods.

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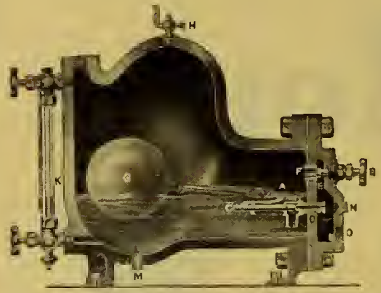

AMERICAN IDEAL STEAM TRAP

Why not arrange now before buying any additional trap equipment to thoroughly try out this Trap?

"THE AMERICAN IDEAL" is a REAL TRAP.

Cannot leak or wire draw.

Larger capacity as compared with other traps. Send for new complete catalog No. 65.

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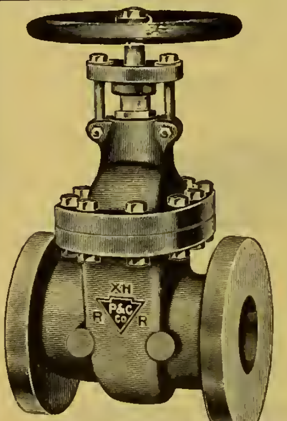
American Steam Gauge & Valve Mfg. Company

New York Chicago BOSTON Atlanta Pittsburgh



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An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.
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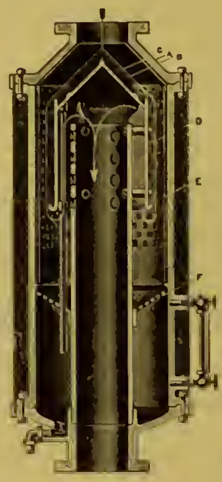
CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS



ARE YOUR RODS WORKING
ON A CONSTANTLY LUBRICATED SURFACE,
OR ON
HARD CANVAS and
FRICTION PRODUCING RUBBER?

"PALMETTO"

will continue to be made of materials that can be depended upon not only to give long service under hard conditions, but the lubricant carried in each single strand of "Palmetto" Packing

KEEPS THE RODS LUBRICATED AND PREVENTS WEAR

Use Braided "Palmetto" on rods.
Use Twist "Palmetto" in small valves.

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Canadian Distributing Agents:
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"The trade mark says 'Spartan.' I suppose it was named after those old Spartans—the fellows who could stand 'most everything.

"This belt was on the machine when I started in here three years ago and it has certainly stood some hard service. Doesn't slip, stretch or glaze. Guess the boss knew what he was doing when he picked this belt —why, it's good for years yet. I'll keep that G & K Spartan trade mark in mind—I may be able to use the information some day."

The operator is pretty close to the belt. He appreciates a good one because he is often the loser from a poor one. Any Graton & Knight belt makes good because it is made from selected hides tanned by superior processes. Heat, cold, strain, water, oil, or acid fumes have no ill effect on "Spartan" Belting. It's the belting supreme.

A New G & K catalog is just off the press. Lists our complete and extensive line—belts for all purposes. A postal brings a copy.

THE GRATON & KNIGHT MFG. COMPANY
Oak Leather Tanners and Belt Makers
WORCESTER, MASS., U.S.A.
Representatives in Canada: THE CANADIAN FAIRBANKS-MORSE COMPANY, Limited.
St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.
"Consult our Engineering Department in connection with your Transmission Problems."

CFM

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Trade Gossip

Grande Prairie, Alta.—R. S. McDonald, of this town, proposes establishing a creamery here.

Vancouver, B.C.—The New England Fisheries Co. will build an extension to their plant, to cost about $50,000.

Redmond Quain, a director of the Ottawa Electric Railway Co. and Ottawa Car Co., died at Ottawa on October 5, aged 56.

Winnipeg, Man.—The plant which the Manitoba Cold Storage Co. propose building, here, will cost approximately $100,000.

Guelph, Ont.—Engineer F. McArthur has made a report recommending an expenditure of $75,000 on waterworks improvements.

Toronto.—The Chapman Valve Mfg. Co., Toronto office, have been awarded a contract for a 36-in., gate check valve by the Board of Control.

Richmond Hill, Ont.—A by-law will be submitted to the ratepayers in January which will enable the municipality to instal a modern water system.

The Canada Copper Co.'s production for eight months at the Greenwood, B.C., smelter, was 3,455,578 lbs. copper, 3,555 ozs. gold, and 33,096 ozs. silver.

Vancouver, B.C.—B. T. Rogers has had his private yacht equipped with a ½-ton refrigerating plant, furnished by the Armstrong Machinery Co., Spokane, Wash.

Barons, Alta.—W. D. Annabell has had his general store equipped with a 1-ton refrigerating plant, supplied by the Armstrong Machinery Co., Spokane, Wash.

Lethbridge, Alta.—The by-law to authorize an expenditure of $100,000 on a water filtration plant was passed by the ratepayers on Sept. 22 by a large majority.

The American Water Softener Co., Philadelphia, Pa., have been awarded a contract for a mechanical filtration plant by the Town Council of New Toronto, Ont.

Montreal, Que.—The Northern Electric Co., Montreal, has secured a contract for about $300,000 worth of underground cables for the Montreal Tramways Co.

J. A. Johnston, who for some time has filled the position of district inspector of the Ontario Hydro-Electric Commission, has been appointed manager of the Brockville Light and Power Department.

The Wm. Hamilton Co., Peterborough, Ont., have received an order from the Houpt Paper Mills for a 30-in. 240 h.p. water turbine to drive the new mill on the Napanee River at Camden East, Ont.

Sherbrooke, Que.—The Waterworks' committee have recommended the purchase of a Gould horizontal pump and turbine combined, of 4,800,000 gallons capacity per 24 hours.

Redcliffe, Alta.—The Town Council are considering the question of installing a steam or gas engine and pump in the municipal power plant. Extensions may also be made to the water main system.

Chemands, B.C.—The Victoria Lumber & Mfg. Co., has had its commissary equipped with a 4-ton refrigerating plant, furnished by the Armstrong Machinery Co., Spokane, Wash.

The Canadian Sarco Engineering Co. have obtained an order from the town of Le Pas, Man., for two De Laval sewage pumps, to be direct connected to Canadian Westinghouse motors.

Aylmer, Que.—The City Council has awarded a contract to the New York Continental Jewell Filtration Co., Montreal, for a mechanical filter for the waterworks plant.

J. Howard Jackson, head of Jackson & Co., civil engineers, died on October 7. He was born in England in 1847, and went to New Zealand in the early sixties. He came to Brantford in 1912 to join his son in the engineering business.

John Power, who for 33 years was superintendent of the Montreal Gas Works, passed away in that city on October 4, at the age of 81. Mr. Power was an Irishman by birth, and came to Canada in 1860. He retired as superintendent of the gas works in 1895.

Lethbridge, Alta.—The by-law to submitted to the ratepayers on October 17 to sanction an issue of $17,076 in debentures to cover the cost of an extension to the electric light systems, an ash flue at the power house, and for extending the electrical system.

The Western Power Co. of Canada, Ltd., has been incorporated at Ottawa with a capital of $10,000,000 to carry on the business of an electric light and power company with headquarters at Montreal. Incorporators are C. M. Holt, A. Chase-Casgrain and E. M. McDougall all of Montreal .

Township of Hibbert, Ont.—A by-law will be submitted to the ratepayers on October 16 to raise $5,000 to provide for the cost of a plant to distribute electric power to be supplied by the Hydro-Electric Power Commission for the police village of Dublin. James Gordon, township clerk.

The Turbine Equipment Co., Toronto, are installing a 24-in. De Laval pump. 16 million gallons daily capacity against 60 ft. head, at Sidney, N.S. It is direct connected to a 250 h.p. Canadian Westinghouse motor.

New Westminster, B.C.—The Dominion Cedar & Shingle Co., in which the contracting firm of Marsh, Hutton, Powers Co,. are interested, have leased a site just east of Lulu Island bridge, New Westminster, and are proceeding with the erection of a modern plant.

Toronto, Ont.—The York Township Council have made satisfactory arrangements with the Hydro Commission's engineers with regard to the supply of light for the township. The council have accepted the engineer's report, authorizing the construction of water mains on Eglinton avenue, Runnymede and Weston roads.

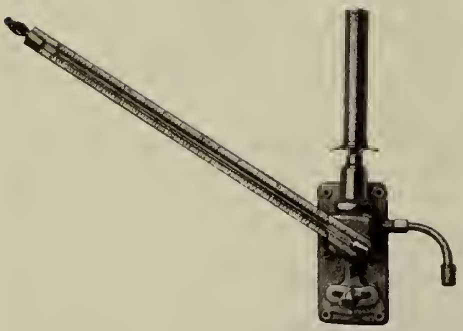
Winnipeg, Man.—A committee of engineers, consisting of Gen. H. W. Ruttan, J. G. Sullivan, and R. S. Lea, have reported that the aqueduct from Shoal Lake to Winnipeg will carry out in every particular the work for which it is designed. They estimated that the work can be completed at a cost of $6,867,700, or about $230,000 less than the original estimate.

Galt, Ont.—A contract has been let to P. H. Secord and Sons, of Brantford, for a large addition to the north works of the Goldie and McCullouch Co. The building is to be 60 by 144 feet of fireproof construction, and will cost $15,000. The work is almost completed on the new $20,000 power house at the south works of the same company.

Dundas, Ont.—The inter-switching station of the Provincial Hydro-Electric Commission, which was burned out about two months ago, is back in service. Chief Engineer F. A. Gaby announced that the work of re-equipping the station had been completed, and that Toronto and other municipalities were now being served via Dundas instead of directly from Niagara.

Assiniboia, Sask. — The following contracts have been awarded for the new power house:—For one 150 h.p. internal combustion engine, to the Canadian Boving Co.; generator exciter switchboard and other apparatus, divided between the Canadian Westinghouse Co. and the Canadian General Electric Co., pumps, motors, piping and air compressor to the James Balantyne Co., Winnipeg; wire and line material, Northern Electric Co.; approximately 17,500 feet of 4, 6, and 8-in. pipe and specials, and twenty hydrants, twenty-nine gate valves and boxes, C. E. Choun, Winnipeg; erection of power station, supply and installation of heating plant,

Universal
LIQUID
MEASURING
Devices



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ALWAYS READY, ALWAYS SURE — ALWAYS KEEPS YOU POSTED ON THE QUANTITY OF LIQUID ON HAND, SAVES MUCH TIME AND PREVENTS "RUNNING SHORT."

Can be placed close to or far away from the liquid. It does not matter where the liquid to be measured is in relation to the device, as all you have to do is to run a piece of ¼ in. pipe from the tank to the instrument and the tank may be below or above ground, or hundreds of feet from the instrument, which latter is placed at any convenient position in the office or desired room.

Drop a line for circular and full particulars.

UNIVERSAL MEASURING DEVICES, Limited
125 ISABELLA STREET, TORONTO

and construction of reinforced cocrete reservoir, J. A. Browley Co. The engineers are Murphy & Underwood, of Saskatoon, Sask.

Winnipeg, Man.—Steps are now being taken to secure the incorporation of the Ontario and Manitoba Storage Co., whose intention it is to build a cold storage plant at the foot of Notre Dame Avenue, for the purpose of keeping perishable fruit shipped in from Ontario in good condition indefinitely. The building will be started this fall. It will have a frontage on Notre Dame Avenue of 170 feet with a depth of 80 feet and a height of five storeys. Charles Chamberlain, of this city, is interested.

Dundas, Ont.—The town council expects to have completed shortly the concrete storage dam at Greensville. By its construction it will give the town a possible reserve storage for its water supply of nearly twenty million gallons of water. This supply will be available without requiring pumping. The dam is of solid concrete construction, and is designed for a head of 23 feet. Its over all length is 100 feet. The work is being carried out under the direction of the Dundas Public Utilites Commission. E. H. Darling is the consulting engineer.

Galt, Ont.—The decision of the Dodge Metal Hose Co., of Canada, Ltd., to erect a $50,000 plant here assures another new industry for Galt. The company is organized under Dominion charter, with an authorized capital of $150,000. The company will manufacture malleable iron hose to replace rubber hose used to couple air line between railway cars, and also has Canadian patents on five other articles. Land has been purchased on Beverly Street, and plans are being prepared for a modern factory by John Evans, architect. James R. Cameron, of Toronto, is to be works manager.

Catalogues

The "S-C" Pump Governor is the subject of bulletin B 25, issued by the "S-C" Regulator Co., Fostoria, Ohio. The distinctive features of this apparatus are dealt with in detail accompanied by a material specification, principal dimensions, operation and rules for installing etc. The illustrations show a sectional view of the governor and also an installation.

The "S-C" Regulating Co., Fostoria, Ohio, have distributed to the trade a bulletin B 26, entitled "Feed Water Regulation Engineering" in which the subject is dealt with in connection with the "S-C" feed water regulator. This type of regulator is illustrated and described and its method of operation is also fully described while mention is

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200—300-light dynamos.
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Enclosed find 10c in stamps, for which send me one large 50c can of U. S. Metal Polish Paste.
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The "Flakes" do the trick—Dixon's Flake Boiler Graphite makes the scale soft and easy to remove, at the same time increasing the steaming efficiency of the boiler to its highest point.

Order the Boiler Graphite that is made by DIXON—the name protects you—it has for eighty-nine years.

Send for booklet 222T, at once.

Made in JERSEY CITY, N. J.,
by the
Joseph Dixon Crucible
Company
Established 1827

made of the exclusive features. A partial list of customers is included.

Fluid Meters.—The Bailey Meter Co., Boston, Mass., have issued bulletin No. 5 illustrating and describing some of the different types of recording meters and testing instruments which they have developed and perfected in recent years. In the introduction the application of the various types of meter is dealt with followed by a full description of each. The illustrations show interior, exterior and sectional views and also typical charts.

Book Review

Central Station Management, by H. C. Cushing, Jr., and Newton Harrison, 397 pages, 7½ in. x 4¾ in. Published by the D. Van Nostrand Co., New York. Price $2.00 net. This is a new book dealing with the principles of central station management as adopted by many successful electric light and power stations in the United States. The various phases of the subject are discussed in a comprehensive and practical manner, emphasis being laid on the necessity of close attention to details; necessary for successful operation. Both the commercial and technical features of central station management are dealt with, considerable space being devoted to the question of rates and cost of power. Other subjects discussed include street and interior lighting, while one chapter is devoted to district heating from central stations, in which it is shown how this can be done with profit. The book contains thirty-two chapters, of which twenty-five are devoted to management and distribution, while the remaining chapters deal in a general way with the power plant end of the subject. The book is not too technical, but contains much valuable information covering a subject full of important details, a careful consideration of each being essential to obtain satisfactory results. Another service the book performs is to show how central stations can be managed efficiently and at the same time with proper consideration of the public which it serves, thus establishing cordial relations between the producer and consumer; a desirable condition for a public service company to operate under. The book is printed in clear type and is bound in substantial cloth covers.

Three Vital
SARCO
Points of Interest
to
Plant Owners
and
Engineers

EFFICIENCY—
Steam trap SARCO works continuously and requires no large storage capacity such as increases the bulk and cost of other steam traps. Its impelling force is an oil hermetically sealed in a strong tube. Temperature changes always affecting this oil similarly. It always expands and contracts the same. It does not lose force with use; nothing can reduce or dilute its expansive energy. Corrugations are spiral instead of annular, and the movement evenly distributed on each turn is very slight.

SIMPLICITY—
Instead of the big, clumsy bucket trap with its floats, levers, valves, water gauges, bowls, toggles, and packing, you have in SARCO a compact steam trap without any troublesome parts to get out of order. It consists of a steam pipe body, can be screwed on anywhere in a steam main or pipe; occupies very little space, and takes the place of an elbow or bend.

ECONOMY—
The 2" SARCO weighs only 18 lbs., including flanged connections, but it discharges just as much as a standard bucket trap weighing 300 lbs. It requires less space, less attention, and costs one-third of what others do. It is the most economical trap on the market. These are some of the reasons why 350,000 SARCOS have been sold.

We have some interesting data for plant owners and engineers. If you are interested write for these details.

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Woolworth Bldg. NEW YORK
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WATER GAUGE GLASSES
Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog
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Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, Minister of Public Works and Highways.

W. C. McGHIE, Chairman of Board.

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FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

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Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

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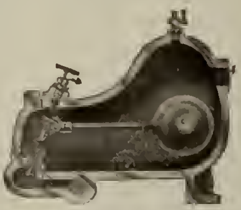

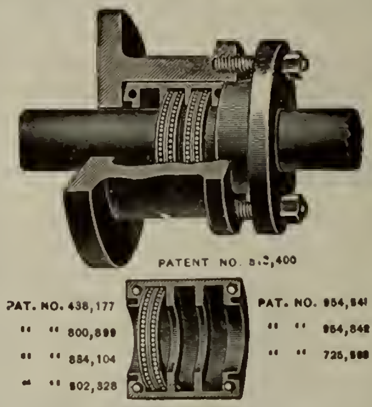

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HOLMES' Metallic Packing

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Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

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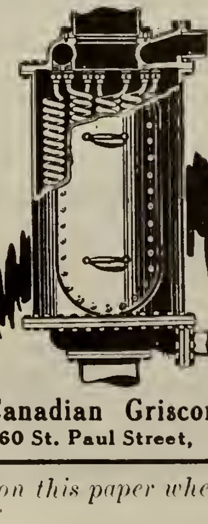

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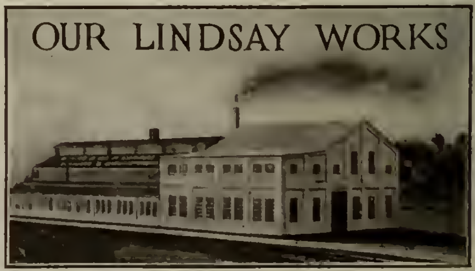

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This belt will give exceptional service for drives except where Belt Shifters are used and except in temperatures 120° F. and higher.

We can, however, furnish you other lines which will fill the above requirements.

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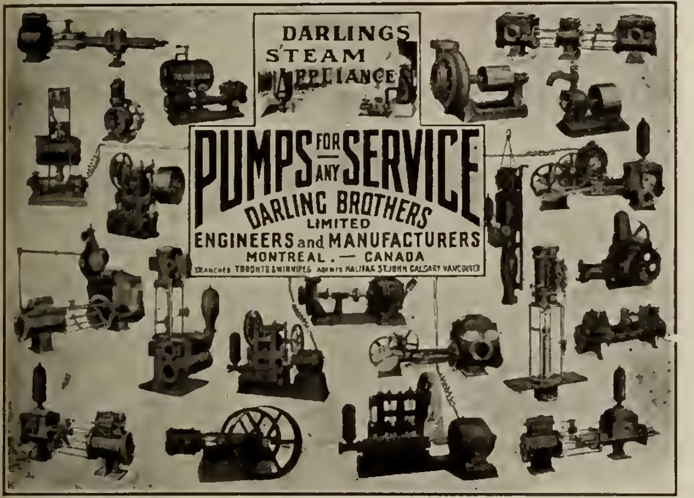

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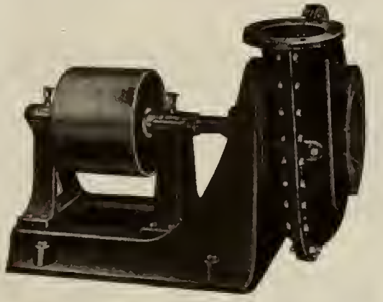

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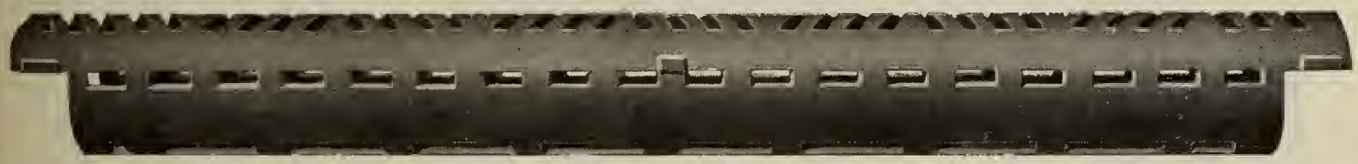

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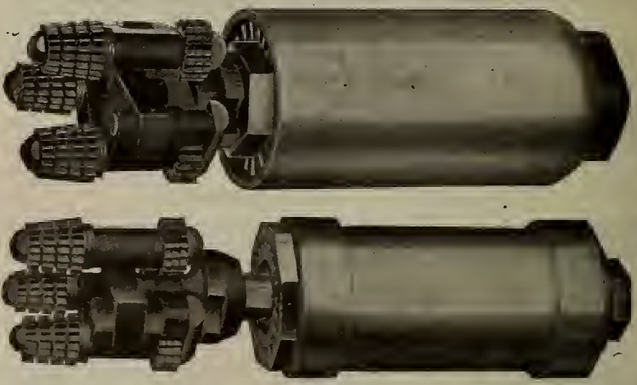
LAGONDA
BOILER TUBE CLEANERS



The latest Lagonda Water and Air-Driven Boiler Tube Cleaners are the most powerful and efficient tube cleaners made. They develop higher speed and greater power than has heretofore been secured with any Turbine Cleaner, and their use will materially shorten the time required in cleaning boilers.

These new Lagonda Cleaners are built for all sizes of tubes, either straight or curved, and they can be driven by water, air or steam.

Ask for Catalog L.

LAGONDA Multiple Water Strainers

The Lagonda Multiple Water Strainer in your water supply main will remove all objectionable solid matter and insure constant and economic conditions of pump and condenser operation. They are easily and quickly cleaned, without interruption of water supply, and take up small floor space. **Ask for Catalog R-2.**

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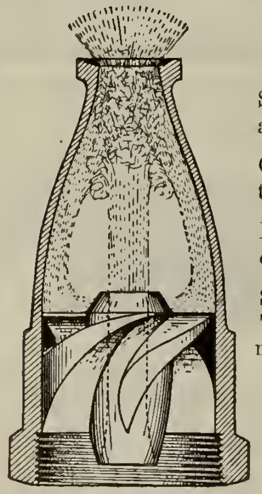

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Spraco Cooling Systems. There is scarcely any depreciation, practically no maintenance cost and they are indefinitely long-lived.

Operating power averages less than 1½% of power generated by engine (average cooling tower requires 3%). Average vacuum year round 28".

For cooling water in abundance for condensers, water jackets, transformers, ammonia coils, etc.

Spraco costs soon come back. The yearly saving will generally pay a 50% return on its cost. The service of our engineering staff is at your disposal at all times. Our booklet shows many installations, both on the grounud and on roofs, when ground space is limited.

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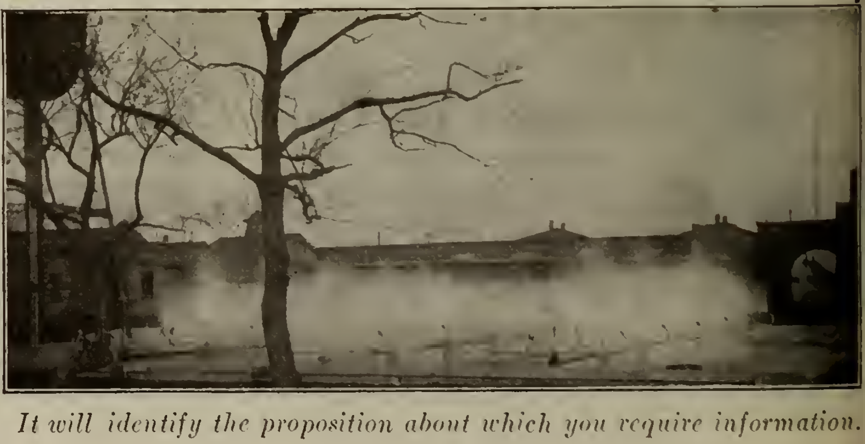

Spray Engineering Company

93 Federal St., Boston, Mass.

Cable Address: "Spraco," Boston
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Homestead Valve Mfg. Co., Pittsburgh, Pa.
York Mfg. Co., York, Pa.

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McAvity & Sons, T., St. John, N.B.

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Graton & Knight Mfg. Co., Montreal.

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Can. B. K. Morton Co., Montreal.

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Graton & Knight Mfg. Co., Montreal.
Lyman Tube & Supply Co., Montreal, Que.
Waterous Engine Works Co., Brantford, Ont.

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Dominion Belting Co., Hamilton, Ont.
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Federal Engineering Co., Toronto, Ont.
Garlock Packing Co., Hamilton, Ont.
Graton & Knight Mfg. Co., Montreal.
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Plewes, E. B., Winnipeg, Man.
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Can. Sirocco Co., Windsor, Ont
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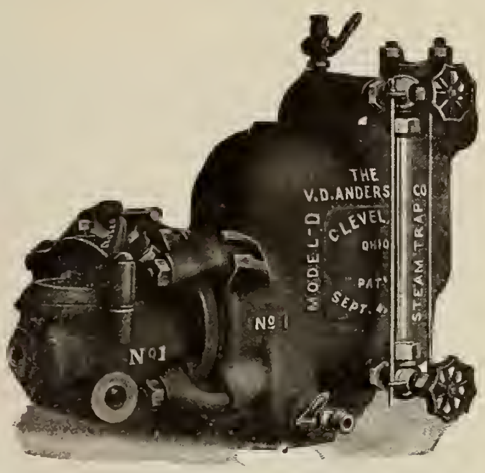

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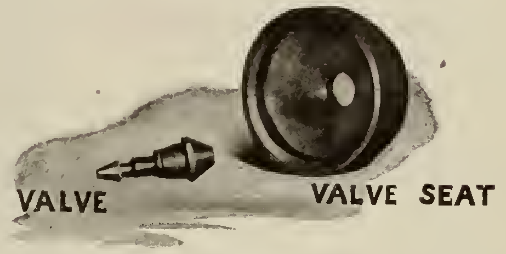

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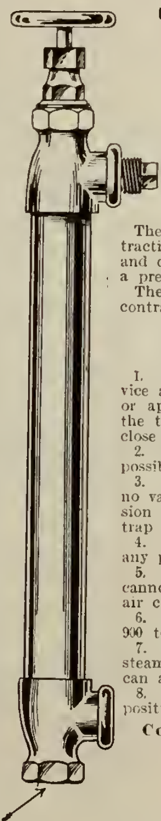

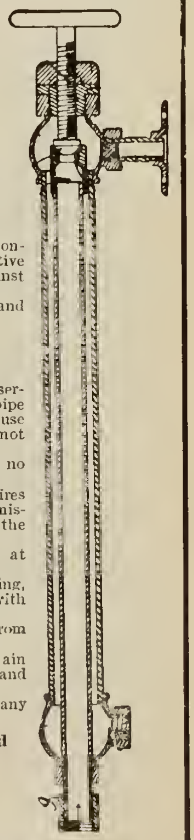

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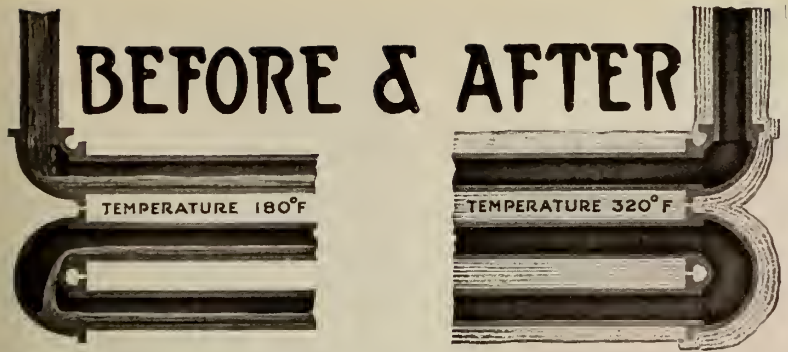

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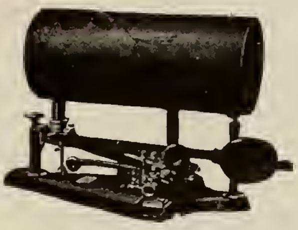

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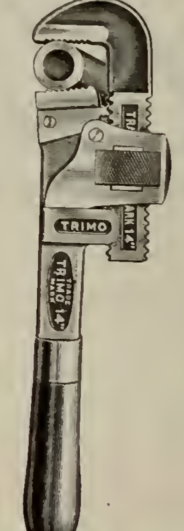

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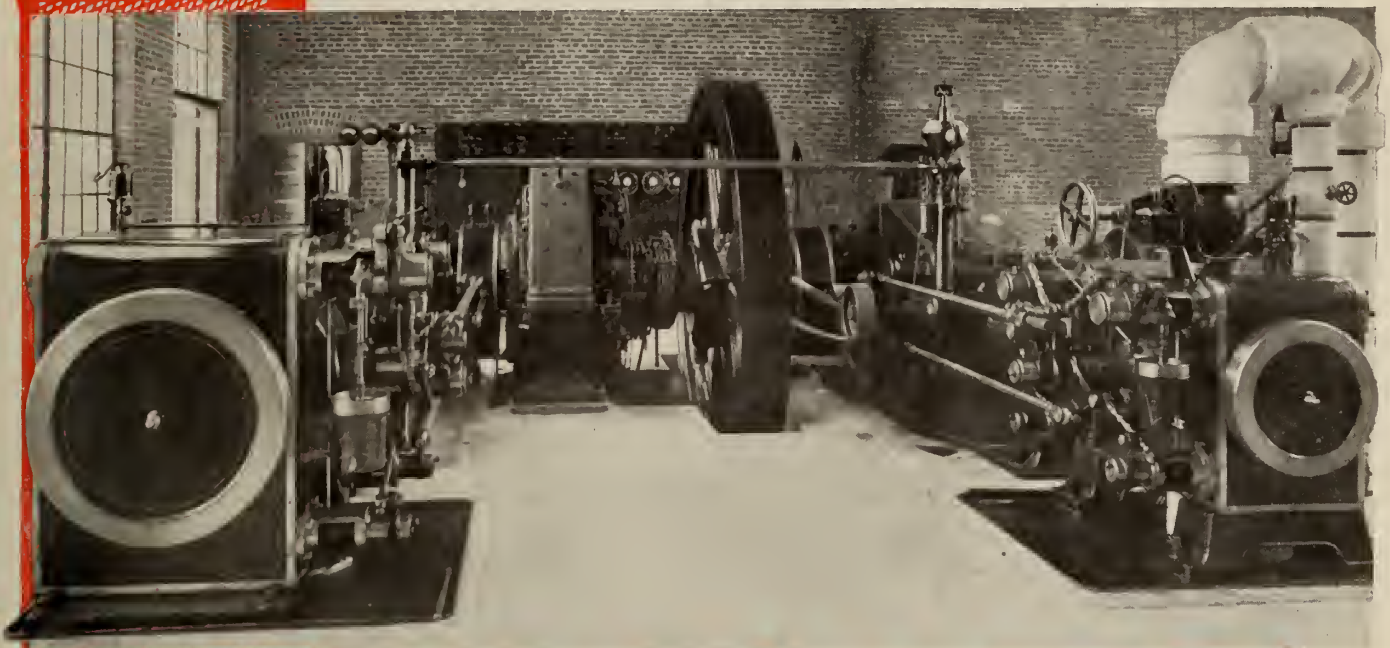

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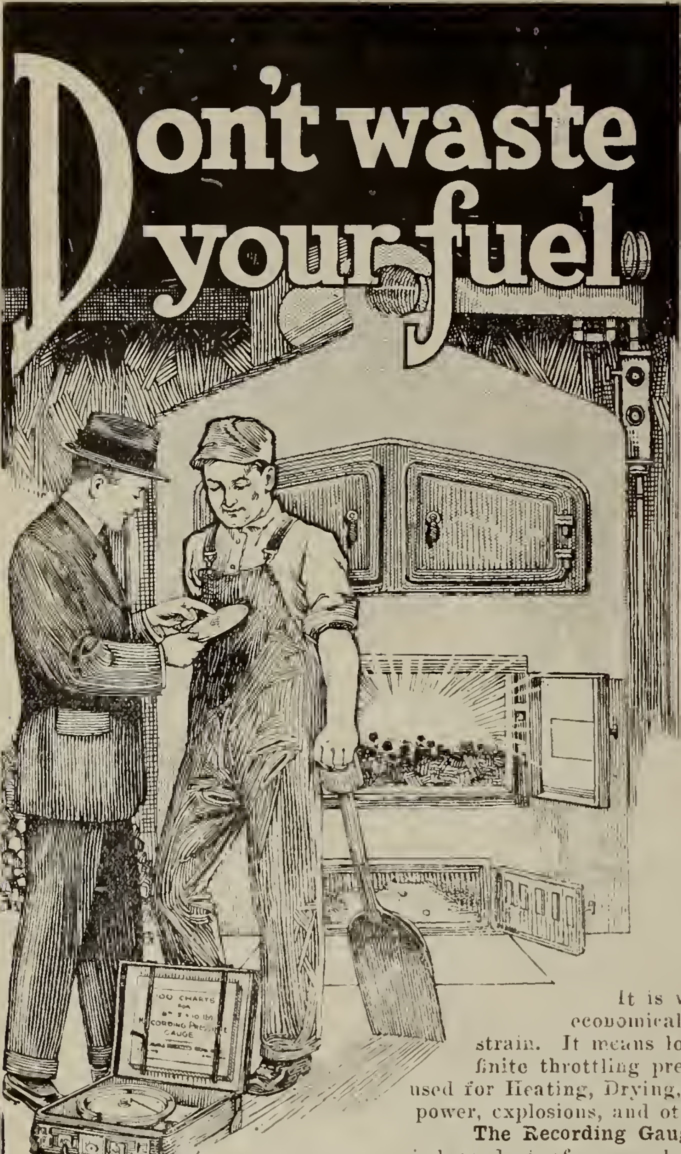

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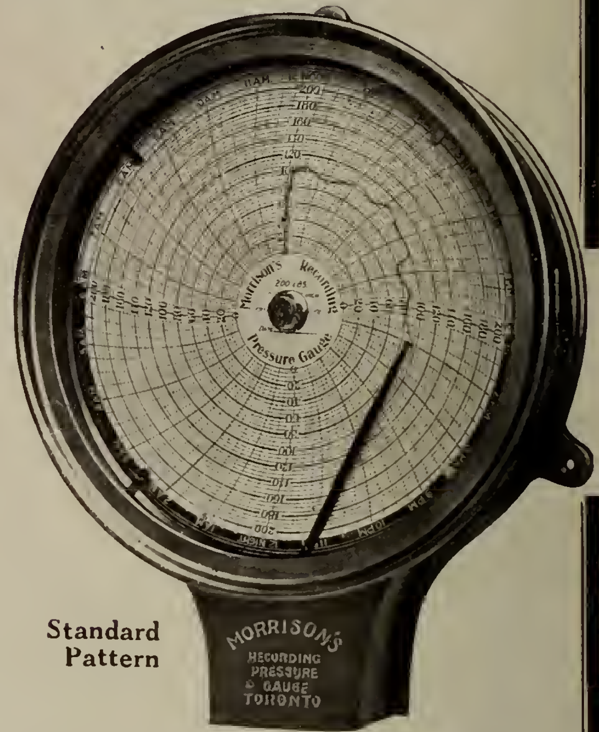
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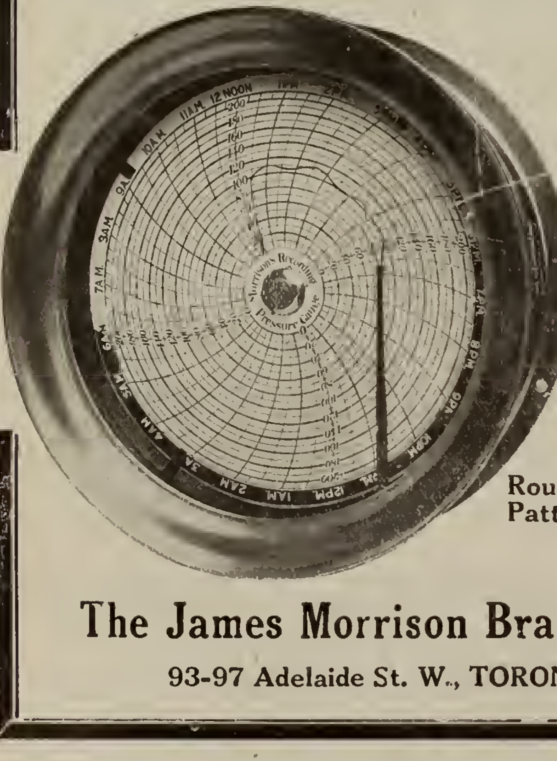

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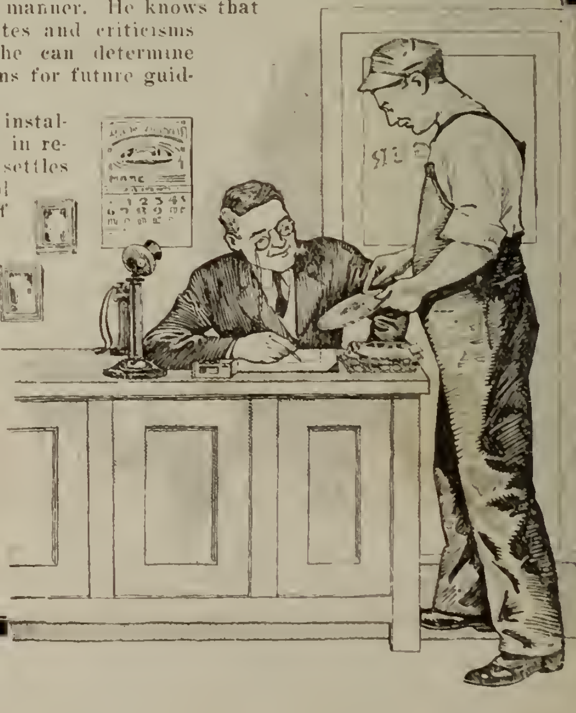

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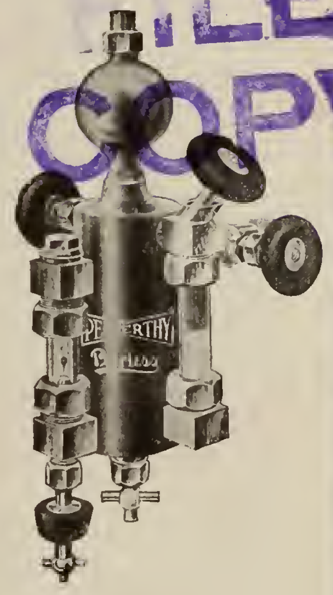

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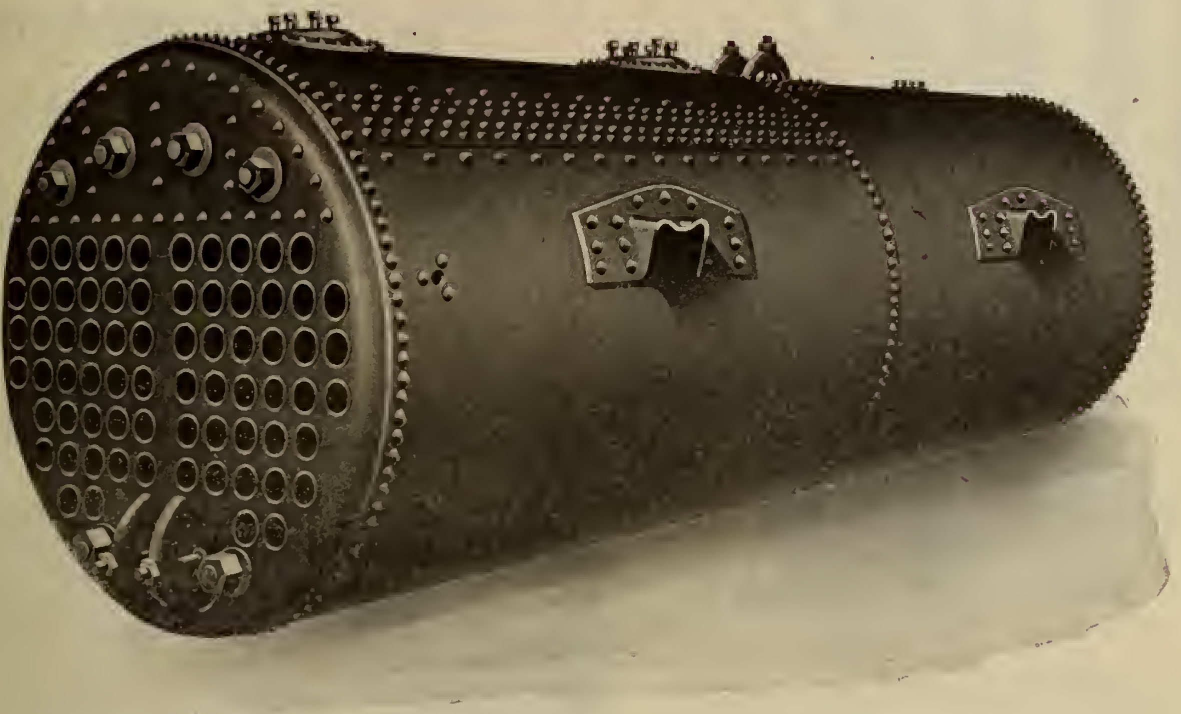

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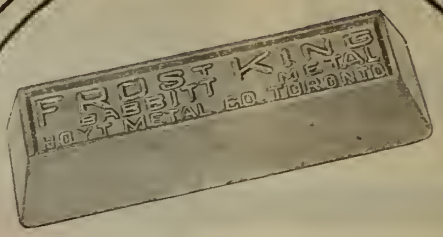

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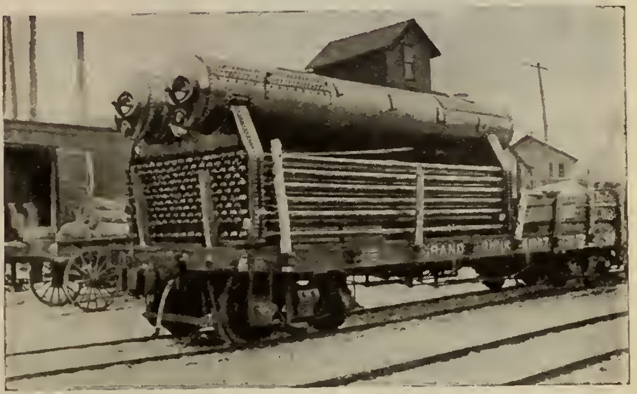

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SHIPBUILDERS, ENGINEERS AND BOILER MAKERS

TORONTO, ONTARIO

Yes, you get steam by firing this way, but what about the cost?

A remarkable change takes place in the cost of power in plants that replace the old method with

Jones Underfeed Stokers

SIMPLEST stokers built; no parts moving in contact with the fire; no grates; no losses through bars; no smoke.

A big paying investment for the large or small plant. Hundreds of them are effecting savings from 15 to 25% in plants like your own.

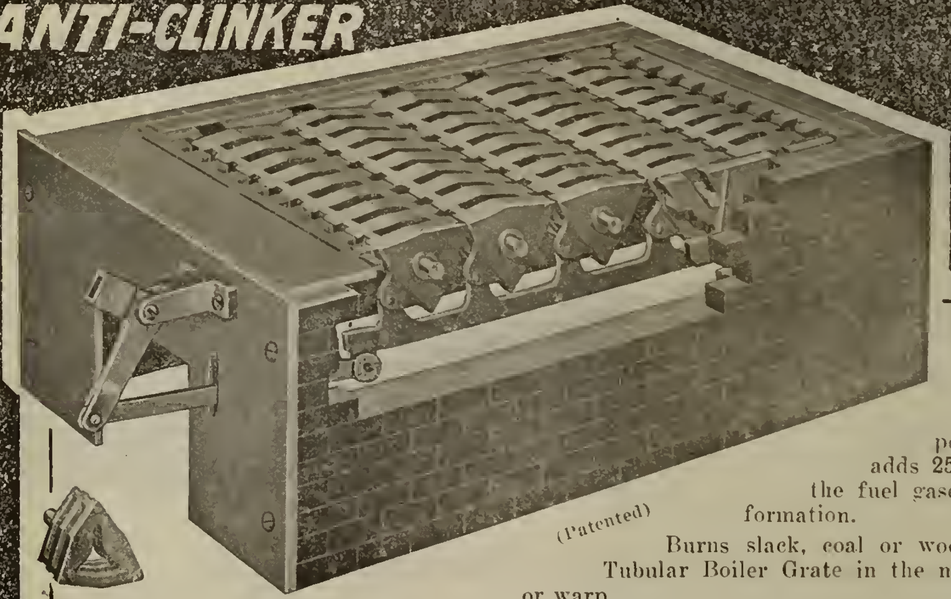
An investigation will prove a good thing. We'll gladly put you in touch with users..

Jones Underfeed Stoker Co. Ltd.
National Trust Building, Toronto

THE JONES STOKER WAY

ANTI-CLINKER

SHELL BAR GRATES



60% of the total fire surface is air space. This abundant air supply commands a perfect combustion which **adds 25 per cent. more heat** to the fuel gases and prevents clinker formation.

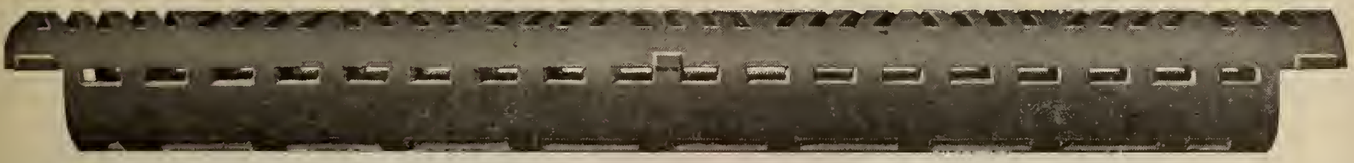
Burns slack, coal or wood. The only revolving Tubular Boiler Grate in the market that cannot twist or warp.

Two grates in one.

By pressing the lever you turn and change the grates, breaking up the coal and giving you a clean fire. **You will profit by getting full details before installing that new grate. Drop us a line now.**

Shell Bar Grate Company, 376 Dufferin St., Toronto, Can.

THOMAS ELLIPTIC GRATE BARS—SHAKING CIRCLE STATIONARY



Increase steam—Save fuel—Save labor—Cost less—Reduce smoke.

Shipped from Hamilton, Ont. **Let us give you complete information**

FOR ALL PROBLEMS—**Steam—Grate Bar—Furnace—write THOMAS**

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.

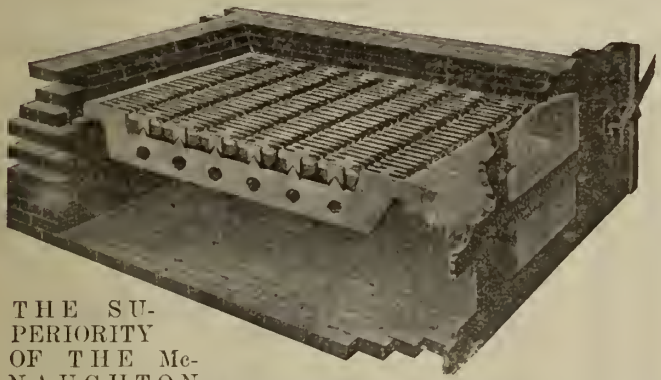
DEPENDABLE—THAT'S THE WORD

FOR

The McNaughton Sectional Rocking Grate Bar

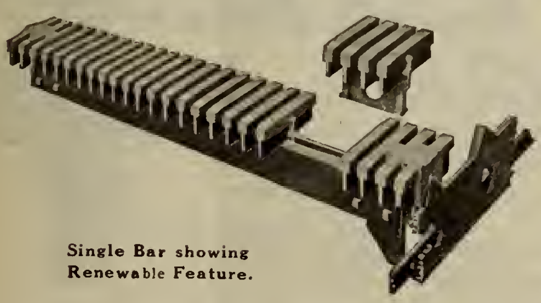
A Perfect Combination to Burn Low-Priced Fuels, Including Lignite.

The Galt Sprinkler Stoker



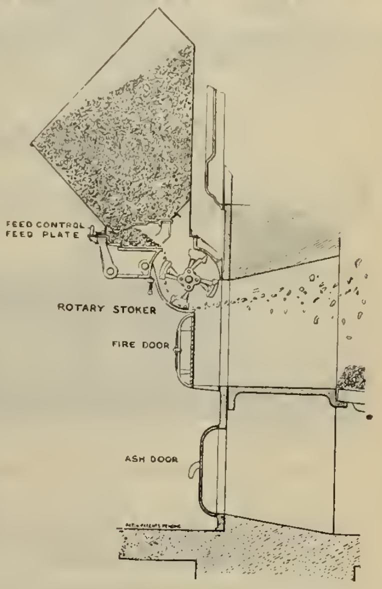
THE SUPERIORITY OF THE McNAUGHTON OVER OTHER GRATES IS ATTESTED BY A LARGE AND UNIVERSAL SALE.

USED IN OVER 1200 POWER PLANTS



Single Bar showing Renewable Feature.

The Stoker feeds continuously, spreading the fuel in a thin, uniform layer over the entire grate area. The fire door is never opened. The feed is regulated to keep exact step with the rate of combustion. As the load on the boiler increases the rate of feed is increased and the stream of fuel flowing into the furnace becomes a little heavier to meet the increased demands. Operates with natural, forced or induced draft and without smoke.



WE HAVE RECENTLY CLOSED ORDERS FOR 30 STOKERS, 9 OF WHICH WERE FOR ONE PLANT.

15,000 FURNACES HAVE BEEN FITTED WITH THE SPRINKLER TYPE STOKER IN EUROPE ALONE, A LARGE NUMBER BEING SUPPLIED TO THE BRITISH NAVY.

LET US TELL YOU WHAT WE CAN DO IN YOUR PLANT

GALT FOUNDRY CO. - GALT, ONTARIO

AGENTS:

OTTAWA, ONT.
Campbell Steel and Iron Works

CALGARY, ALTA.
The Western Supply and Equipment Co.

EDMONTON, ALTA.
W. J. Yeo & Co.,
210 McLeod Block

MONTREAL, P.Q.
The R. E. Cleaton Co.,
Coristine Bldg.

PEILER'S SERVICE—

THE simple matter of buying goods at one price and selling at another never made a successful business. The ***Element of Service*** is what adds permanence to any organization, and the success of such organization is measured only by its ability to serve. The factor of ***SERVICE***—to the customer—always has been, and is, what has guided us in making connections with manufacturers of power plant specialties.

WE have had many years' experience solving difficult power plant questions, of all kinds and conditions, and the benefit of this experience is yours in dealing with us. If your conditions are not suitable for equipment supplied by us, we do not hesitate to advise what we think will overcome your difficulties.

ON this, and the opposite page, a few of our lines are shown. In our opinion, after long experience, with many tests and trials, they are the best, will stand up the longest, and give the most efficient service, of any that are made on the continent.

H. L. Peiler & Co.

311 Kent Building, Toronto, Ont.
380 St. James St., Montreal, Que.

We solicit your enquiries.

You, Mr. Engineer

can greatly reduce your firm's fuse expense—in fact you can cut it down 80 per cent. by using

"ECONOMY"
Renewable Cartridge Fuses

They are no experiments—millions of them are in use.

Made in Canada and sanctioned by the Canadian Fire Underwriters' Association

Free samples of any desired types and capacities sent with Catalogue No. 24. List of prominent users included

ECONOMY FUSE & MFG. CO. OF CANADA, LIMITED

UNITY BUILDING - MONTREAL

Manufacturers in Canada of "S. & C." High Potential Fuses,—to 150,000 Volts.

MASON
Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

CANADIAN AGENTS
H. L. PEILER & CO., MONTREAL and TORONTO

WHY

worry because you cannot keep up steam pressure

WHEN

it is so easy and cheap to overcome your difficulties by installing a

COPPUS TURBO BLOWER

It means constant steam pressure, regardless of uneven loads, poor draft and poor coal, and it will pay for itself in a short time on account of better combustion. It also will increase your boiler capacity to 200, and even 300%, of its normal rating without injury to the boiler. Cut out this Ad., put your name and address on the margin and mail to us. Without further trouble you will get all the particulars.

500,000 H.P.

in boilers equipped with Coppus Turbo Blowers in four years.
The Coppus has replaced a great many other blowers, but no other blower has ever replaced a Coppus.

Coppus Engineering & Equipment Company
167 Union Street, Worcester, Mass.
Canadian Sales Agents:
H. L. Peiler & Co., Montreal and Toronto.

Bundy Steam Traps

When you get heat into water, keep it there! Keep it there and hold it there as long as possible, no matter where the water goes. This is the idea which the makers of the

BUNDY STEAM TRAPS

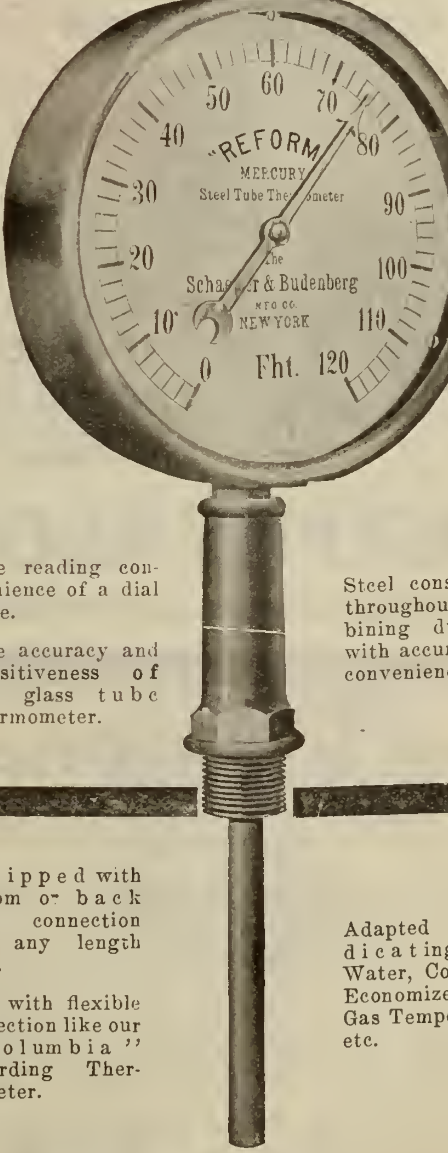
have been driving home to power plant men for years.

BUNDY STEAM TRAPS
combine Power, Simplicity and Efficiency

Nashua Machine Company
Manufacturers
Nashua - New Hampshire

H. L. PEILER & CO.
380 St. James Street - - Montreal
Are Our Agents in Canada

"REFORM"
Mercury Actuated Dial Thermometer



The reading convenience of a dial face.

The accuracy and sensitiveness of the glass tube thermometer.

Steel construction throughout, combining durability with accuracy and convenience.

Equipped with bottom or back rigid connection and any length stem.

Also with flexible connection like our "Columbia" Recording Thermometer.

Adapted for indicating Feed Water, Condenser, Economizer, Flue Gas Temperatures, etc.

Ask for Pamphlet
W-101

THE Schaeffer & Budenberg MFG. CO.

Makers of "Columbia" Recorders, "Crescent" Thermometers, S & B Gauges, Tachometers, Counters, Calorimeters, Indicators, etc.

Berry and South 5th Streets, Brooklyn, N. Y.
Also Chicago, Philadelphia, Pittsburgh.

Murphy AUTOMATIC Furnace

Murphy Automatic Smokeless Furnaces

Canadian Repeat Orders Since January 1st, 1916

The Laurentide Co., Ltd.,	Grand Mere, P.Q.
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and Thirty-three Repeat Orders from American Users—one of which was **18th contract**; the 18 contracts cover **136 MURPHY FURNACES**

Write to-day for Catalogue

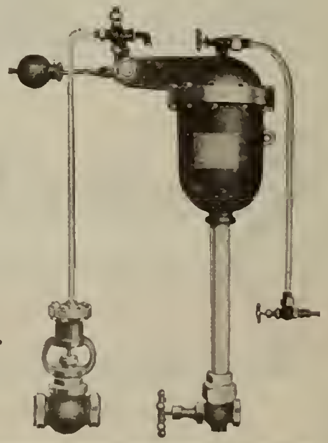
MURPHY IRON WORKS, BUFFALO, N. Y.
DETROIT, MICH.

Once Is Too Often

Once Is Too Often for Accidents to occur due to high or low water. They can be prevented and should be prevented.

The **Vigilant** provides absolute prevention from dangers from this source. The heavy displacement used is positive acting under any conditions. It keeps water level always within ¼ in. of middle gauge. There is nothing about it to get out of order—its construction is very simple.

The economy of the **Vigilant** is another point. It actually pays for itself, as it effects a saving in coal of from 3 to 17 per cent—this from accurate record.



We have a set of engineer's data cards for you. They'll prove very useful. Send for them to-day.

The Chaplin-Fulton
Manufacturing Co.
28 Penn Ave., Pittsburgh, Pa.

Mechanical Regulation of Boiler Feed Water

By the use of the "S-C" method you are assured of a continuous feed at all times load is on boiler. The graduation in rate of feeding is entirely dependent upon the load and fire conditions. The Regulator will carry a constant level on steady load—higher level on light load and lower level on peak loads. Variation in water level is entirely dependent on inclined position of generator which is adjustable while operating under full load.

Bulletin No. 80 explains all.

Generator or Actuating end of Regulator.

Regulating Valve Placed at Any Point, Any Position.

The "S-C" Regulator Company
Feed Water Regulation Engineers
FOSTORIA, OHIO, U.S.A.

Mr. Engineer, Allow Us to be Your Chemical Adviser

Water Treatment An Exact Science

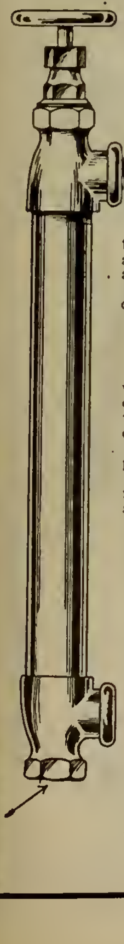
There are no mysteries in the chemistry of waters and the impurities contained. Just as some substances taste sweet to the tongue, some sour, some bitter, and some biting, so each mineral salt in water has its own particular manner of behaving.

Each of these alone would always behave exactly the same way under the same conditions, but they are rarely, if ever, found alone. The complication in the whole subject is in figuring out how the *combinations* of impurities, in certain varying percentages, will behave under varying conditions of temperature and pressure.

This is where our extended experience and scientific methods excel. It is where the cure-alls and mechanical systems fail.

Dearborn Chemical Company
of Canada, Limited

1220-30 Dundas Street
TORONTO - ONT. - CANADA



The Long
Patent
Steam Trap
Has but One Moveable Part

The valve actuated by the expanding and contracting of a tube, a motion that is positive and of sufficient force to close the valve against a pressure of two hundred pounds.

The movement is due to the expansion and contraction of metals.

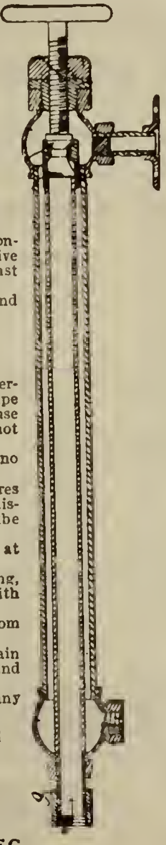
Its Advantages

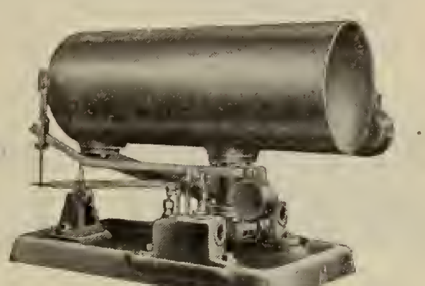
1. Before the Long trap goes into actual service all air and water is expelled from the pipe or apparatus to which it is connected because the trap is wide open when cold, and does not close until steam appears.
2. When the Long trap is used there is no possibility of freezing if set so as to drain.
3. The Long trap is automatic and requires no valves except those which control the admission of steam to the apparatus to which the trap is attached.
4. The Long trap is regulated to work at any pressure between 1 and 200 pounds.
5. The Long trap being open at starting, cannot become air bound, thus doing away with air cocks or vents.
6. The Long trap is capable of draining from 900 to 1,500 feet of one-inch pipe.
7. The Long trap may be applied to drain steam mains, jacket kettles and separators, and can also be used in drying room systems.
8. The Long trap can be installed in any position desired.

Correspondence from Heating and Power Engineers invited.

J. T. LONG

84 Adam Street
MAISONNEUVE, MONTREAL, QUEBEC
Patentee and Manufacturer





Paid For Itself in Thirty Days

The chances are that if a device does not prove its worth in thirty days there is little chance that it ever will. But think of this

"Detroit" Systems for Handling Condensation

have records of paying for themselves in thirty days.

Not only will a "Detroit" System pay for itself in a short time, but will continue to save hundreds of dollars a year right in your boiler room by saving fuel.

In your boiler room, as in many others, there is perhaps adequate provision made to return the condensation.

Better let us send you "Watch Your Condensation."

CANADIAN *Sirocco* COMPANY
LIMITED

WINDSOR. ONTARIO.

SALES OFFICES:

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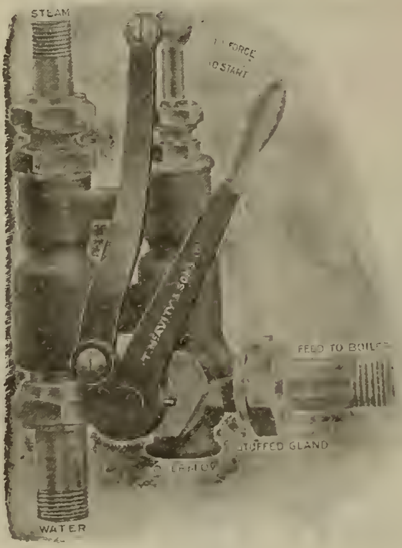
A. M. Nichol, McGill Bldg., Montreal.
S. S. Clarke, 605 W. Second St., Calgary.
W. W. Hicks, 567 Banning St., Winnipeg.
Canadian Sirocco Co., Ltd., 604 Credit Foncier Bldg., Vancouver.

"McAVITY"

Model 90

BOILER FEEDER

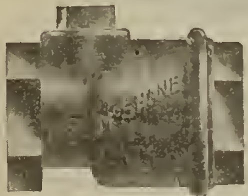


A Simple Movement Starts
or Stops it.

"McSHANE"

Straightway Swinging

CHECK VALVE



Exterior View

Interior View

For Use Upright or Horizontally.

T. McAvity & Sons

LIMITED

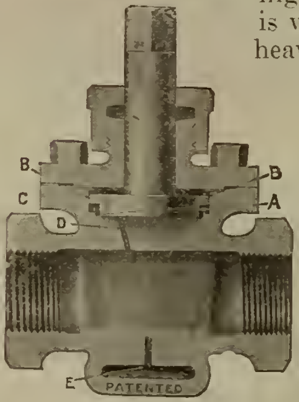
Hardware and Metal Merchants,
Brass and Iron Founders

St. John, N.B. - - Canada
Montreal Winnipeg

"Homestead" Quarter Turn Valves

Open and close easily. The patented balancing parts positively cannot stick.

When this valve is open the two surfaces which are depended upon for tightening are in no way affected by the material passing through. The plug cock provides a straight-way opening, which is desirable in all sorts of work, but is particularly important in high-pressure service. It is very useful when thick, heavy liquids are handled. With the "Homestead" valve you get *all the advantages of safety, economy and efficiency.*



AMONG USERS ARE THE LARGEST MILLS, MINES AND RAILROAD COMPANIES.

It will pay you to try them.

Homestead Valve Manufacturing Co.
PITTSBURGH, PA.
Works: Homestead, Pa.

CURTIS

Engineering
Specialties

CURTIS Water Pressure Regulator

The Economy of this Curtis Water Pressure Regulator (See Illustration) lies in the fact that it greatly reduces the cost of keeping plumbing in order—This by obviating the wear and tear of water hammer or concussion in pipes.

This regulator is warranted to maintain the pressure desired, **with perfect uniformity, regardless of any fluctuations of outside pressure.** The workmanship and material of the Regulator **cannot be excelled.** Trouble from rust or clogging is **entirely avoided.** Delivery of water into service pipes at any desired pressure **is guaranteed.**

Send for special leaflet and price list to the manufacturers.

JULIAN D'ESTE COMPANY
26 Canal Street, BOSTON, MASS.

From the time when put in service and for years after they are installed

JENKINS BROS.'

TYPE "K"

BRASS GATE VALVES

TRADE JENKINS MARK
Jenkins Bros.

are a source of satisfaction to the user. With a little attention now and then they will give *permanent* service and satisfaction.

They do not give out or require replacement, because in their manufacture the most careful attention is given to every detail in design, material and workmanship.

Fig. 300
TYPE "K"
BRASS GATE VALVE
(Screwed)

Approved for use in Ontario and the Western Provinces by the Depts. of Public Works.

WRITE FOR CATALOGUE No. 8

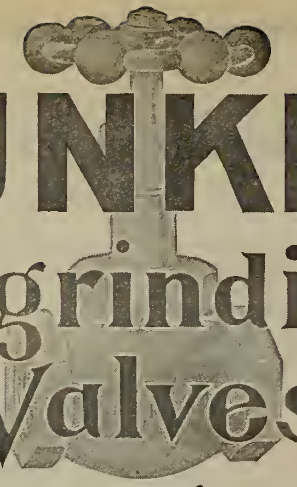
TRADE JENKINS MARK
Jenkins Bros.

Jenkins Bros. LIMITED

TRADE JENKINS MARK
Jenkins Bros.

103 ST. REMI ST. MONTREAL

LUNKENHEIMER



Regrinding Valves

After years of service ——

Should the seating surfaces become worn,—by the simple process of regrinding, (an operation easily accomplished without the use of special tools) the valve is made as serviceable as when new. This operation can be repeated quite a number of times, and it is safe to presume that a Lunkenheimer Regrinding Valve will outlast the connecting pipe.

They have more than half a century of satisfactory service to their credit; are in use and giving satisfaction everywhere.

Made with Inside Screw and Outside Screw and Yoke for 200 and 300 pounds working steam pressures.

Buy the best—they are the cheapest.

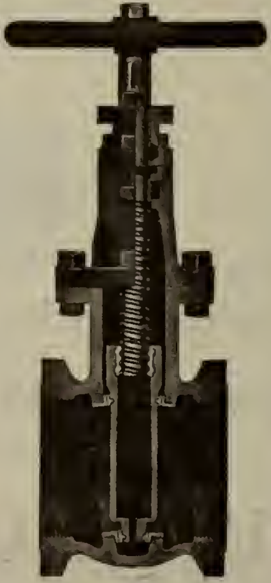
Your local dealer can furnish them; if not, write us. Write for Booklet No. 517-DC.

THE LUNKENHEIMER CO.
"QUALITY"
Largest Manufacturers of High-Grade Engineering Specialties in the World
New York Chicago CINCINNATI, O., U.S.A. Boston London

KERR

("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.



If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

You Pay for Results

You are not called upon to pay one cent for

"Imperial" Boiler Coating

until it has proved to your satisfaction that it's a positive remedy for boiler scale troubles.

Imperial Boiler Coating is not a boiler compound.

It contains in highly concentrated form all the best chemicals and vegetable extracts known for removing scale, combined with a peculiar paint or coating which forms on the boiler metal and resists all scale formation and pitting. No acids, graphite, or other harmful ingredients are used.

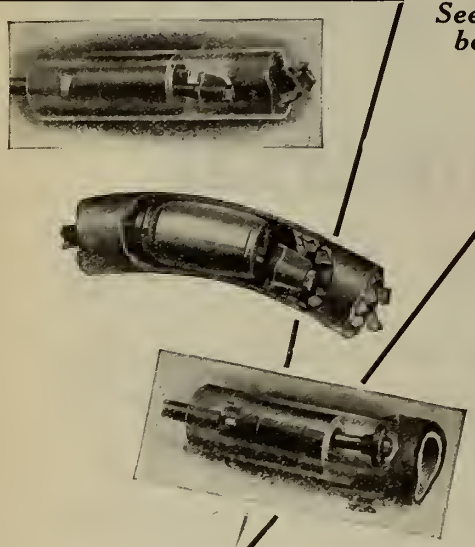
We know from practical experience of all users that our method of boiler treatment for scale prevention is absolutely satisfactory and so confident are we of this fact that we have made the above offer of "Satisfaction or no pay."

Write us to-day.

Crown Manufacturing Co.

CLEVELAND, OHIO

A Louisiana Lumber Company Generated $33\frac{1}{3}\%$ More Steam Using This Tool



See Square below

The Pelican Cooperage & Lumber Co., Mound, La., required 33 1-3% more steam. At first, they thought about installing a new 150 H.P. boiler. Then they saw one of our advertisements, sent for a tool, cleaned up their boiler tubes and produced 33 1-3% more steam—with the

Dean Boiler Tube Cleaner

You may try this cleaner in one of your own boilers FREE. Simply write "**Send me a Dean for free trial,**" giving type of your boilers and outside diameter of the tubes. There are no strings to this offer. You are the judge. If the tool is not satisfactory, you ship it back at our expense; if it is O.K. we issue with every Dean Cleaner sold a guarantee that it will pay for itself in six months' time, or your money back.

Write, anyway, for booklet 136, "The Logic of the Dean."

YOU TRY IT
FREE

Dean

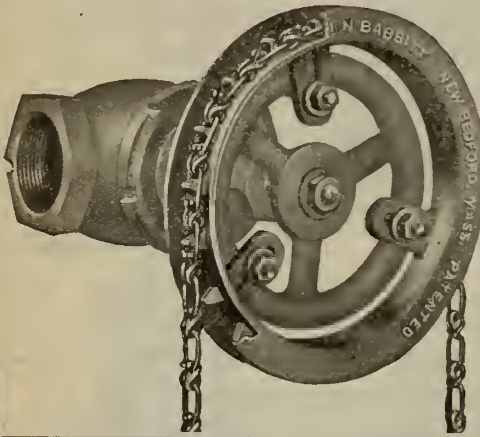
The William B. Pierce Co.

153 Ellicott St.,
Buffalo, N.Y.

201-2 Coristine Bldg.,
Montreal, Quebec

Winnipeg Representative: W.W. Hicks, 567 Banning St.

Dean



Goes Right on Your Present Valve Wheel

"Goes on" is about right, too, it's so easy to apply, and by putting a

Babbitt Adjustable Sprocket Rim

on each of those hard-to-get at overhead valves you can save a lot of time you now spend in hunting ladders and all the risk you now run in using them after you've found them. One concern that thought two would do, bought 27 in a little over two months. The price will encourage you to have enough of them.

Ask your dealer. Write for Illustrated Folder.

Babbitt Steam Specialty Co., 59 So. Water Street, **New Bedford, Mass.**

The R. E. Cleaton Co., 20 St. Nicholas St., Montreal, Que.

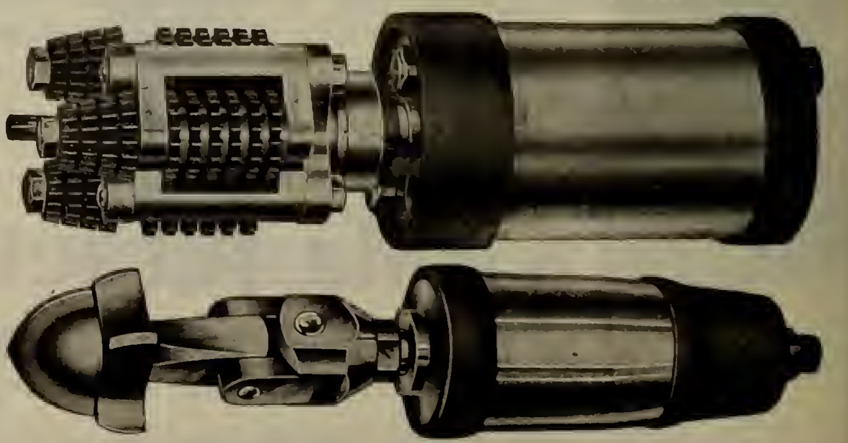
ROTO TUBE CLEANERS

Type A. D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.
The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.

THE ROTO COMPANY

Write for Catalog HARTFORD, CONN.



I've got to hand it to you

"It" is my new booklet. It's just chock full of things you ought to know about me and my method of saying "vamoose" to scale.

Tells why I do not affect the water, nor the transmission of heat—

Tells why I am economical (one small dose a day does the trick).

Tells why I eliminate frequent washing down of the boilers—

And why I do not injure iron, packing, gaskets or lubrication.

Yes, I've got to hand it to you—

Will you signify your willingness to receive a copy, **to-day?**

Perolin

The Boiler Metal Treatment

MADE IN CANADA

PEROLIN COMPANY OF CANADA, LIMITED

Office and Factory: 858 Dupont Street, TORONTO, ONTARIO

PEROLIN AGENTS: Engineers Supply Company, Winnipeg, Man. H. L. Peiler & Co., 380 St. James St., Montreal. Western Supply & Equipment Co., Limited, Calgary, Edmonton and Lethbridge. Bayfield & Archibald, 334 Seymour Street, Vancouver, B. C.

“New Departure” Ball Bearings

For Autos, Motor Trucks and Machine Tools

“New Departure” Ball Bearings are produced in the largest ball-bearing manufacturing plant in the world, and are used in over 75% of the motor cars on this continent.

The “New Departure” line is most complete, comprising the regular annular single row ball-bearings, cup-and-cone or “take-up” bearings, and the

“New Departure” Double Row Ball Bearing

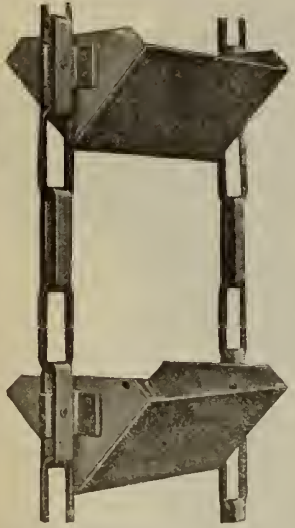
This is a distinctive “New Departure” design that in a single unit combines the greatest capacity for carrying all loads from any direction. It will take radial loads 1-3 to ½ greater than will a single row bearing of the same bore and diameter —a thrust, when no other load is present, of nearly twice its radial load capacity—or a combination load many times greater than that of a single row bearing.

This double function makes it the most efficient and economical anti-friction bearing for 75% of the places where ball-bearings can be properly installed.

Write for Catalogue and full information to

Lyman Tube & Supply Company, Limited

323 St. James Street, Montreal 33 Melinda Street, Toronto



V-Buckets in a vertical position. Furnished with and without guides for chains.

For Small Power Plants Select a

Jeffrey STANDARDIZED V-Bucket Elevator Conveyer

Especially adapted for handling slack and stoker sized coal.

The V-Bucket Conveyer is low in first cost; simple, durable and economical in operation.

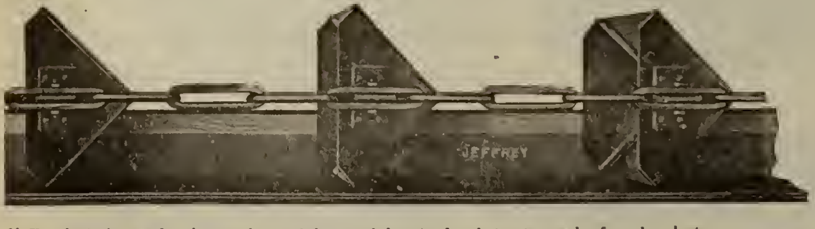
May be used either as a Run-a-Round Conveyer or as a Combined Elevator and Scraper. Built in various sizes of both buckets and chain to meet capacity requirements.

Send for Bulletin on Jeffrey Coal and Ashes Handling Machinery. Address Dept. A-4.

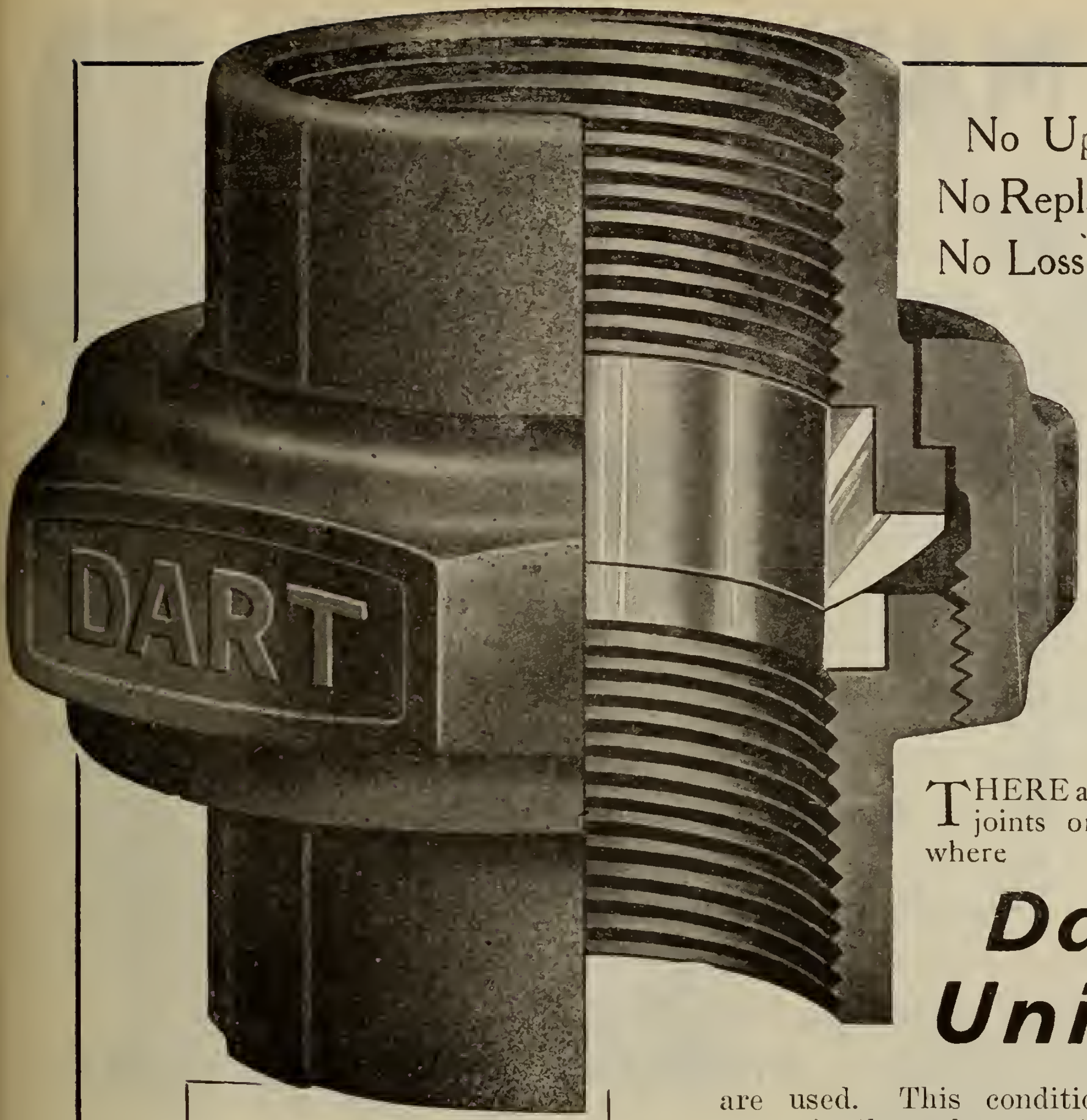
The Jeffrey Mfg. Co.

Canadian Branch and Warerooms:
MONTREAL

A Combined Elevator-Conveyer V-Bucket System, which has given years of hard service. Coal passes direct to elevator or first through crusher beneath tracks and then to elevator.



V-Bucket in a horizontal position with steel plate trough for buckets and steel bar strips under chains.



No Upkeep Cost
No Replacement Cost
No Loss from Leaks

THERE are no leaking joints on the piping where

Dart Unions

are used. This condition not only saves in the upkeep cost, but it is a positive protection against damage being done by the constant drip, drip, drip from union leaks. You know damage caused by drips is often exceedingly costly.

Once Dart Unions are connected all cost is ended—they never need to be replaced—and are trouble-proof.

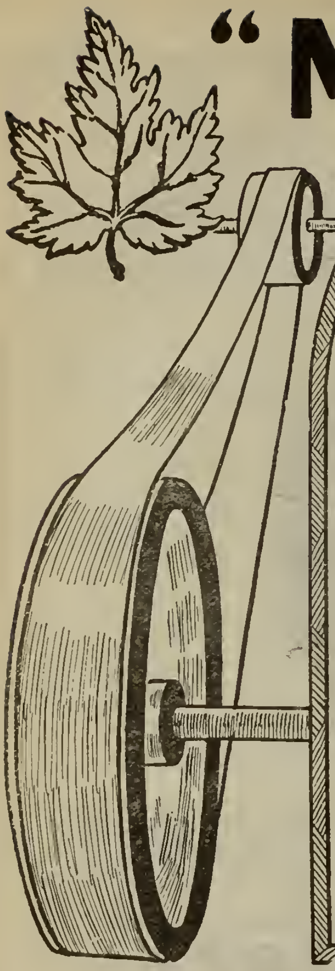
What you need to do is to get "Dart" Unions, put them into use and watch results. You will soon realize that they are exactly as we claim—permanently tight and economical.

Your dealer has them.

Bronze
to
Bronze
at the Joint

THIS MEANS NO
RUST OR CORROSION

Manufactured by
The Dart Union Co., Limited
Toronto, Canada



"MAPLE LEAF"

Stitched Cotton Duck

Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.
A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

SEE THE NAME?

THAT'S SAWYER STITCHED CANVAS BELTING

Quality Stands Out Like The Name After Twenty Eight Years of Hard Work

Look For The Name
And Be Sure

TRADE **SAWYER** MARK
Registered

E. B. PLEWES CO., DISTRIBUTORS.
"A good concern to do business with"
120 LOMBARD ST. WINNIPEG

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs.

SAFETY PLASTIC

METALLIC PACKING

FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
Packing furnished in bulk and in thin Cotton Tubes, sizes 3-16 to $1\frac{1}{2}$ inch, 36 inches long, or in special lengths to fit your stuffing boxes.
Empty Cotton Tubing in assorted sizes FREE OF CHARGE with orders for the packing in bulk form
The tubes are easily filled and they save you the expense of carrying a large stock of packings in different sizes.

Send for FREE SAMPLE and particulars.

MANUFACTURED ONLY BY **STEEL MILL PACKING CO., WINDSOR, ONT.**

Practically Frictionless

Any Quantity sent on APPROVAL

THE BELT WITH A GRIP

"Lincona"

"Lincona" will give you the maximum transmission of power

BALATA BELTING

will pick up a load suddenly better than any other type of belting

BECAUSE

it has a GRIP that no other belting has and requires no dressing.

"Lincona" is the strongest Balata Belt Made.

The tensile strength of "Lincona" is almost double that of leather belting and there is less stretch and straighter running than any other type of belting.

The secret of the greater strength of "Lincona" Balata Belting is in making the Balata a fluid which will saturate the duck, instead of a paste placed on and rolled in. The fluid Balata used in the "LINCONA" process also allows the duck to be compressed more closely, so producing a Belt thinner for the number of plies. This gives a stronger wearing surface to the pulley and less friction.

"Lincona" Balata Belting can be exposed to snow, rain and every condition of weather without injury. It can be run in water without trouble. Write us about your specific needs.

Manufactured by

JAMES DAWSON & SONS, LIMITED, - LINCOLN, ENGLAND

The Canadian B. K. Morton Company, Limited

49 Common Street, Montreal 86 Richmond St. East, Toronto

Austen Bros., Limited, Halifax, N. S. Sherwood & Fraser, Limited, Winnipeg, Man.
Western Oil & Supply Co., Vancouver, B.C.

"FIVE LINKS"

in the Chain Which Joins a Modern Steam Plant with Highest Efficiency.

"Link" No. 1— Garlock Style No. 200 is unsurpassed for use on rods working against high pressure and superheated steam, for expansion joints and rods running in oil, grease and acids.

"Link" No. 2— Garlock Style No. 5 will give excellent service for low pressure steam and hot water.

"Link" No. 3— Garlock Style No. 285, when used with Style No. 286, which is cut sectional, will give excellent service on ammonia rods.

"Link" No. 4— Garlock Style No. 333 is unequaled for medium pressure steam, hot water, etc.

"Link" No. 5— Garlock Style No. 336 is adapted to rods not running true or that are badly scored.

Write for our new catalog.

The Garlock Packing Co.

Hamilton - Ontario

Branches in Principal Cities

This Mark of Dependability

The Hides of the choicest steers, long experience and the Genuine British Oak tanning Process stand behind every inch of

D. K. McLAREN'S

GENUINE OAK

REGISTERED TRADE MARK

LEATHER BELTING

The use of this belting reduces slip to a minimum, thereby saving a considerable amount of power. It also saves a remarkable amount of time, labor and attention, because there is practically no stretch.

THE BELT WITH EXTRA LIFE

The toughness and durability of D. K. McLaren's belting makes lasting qualities that are surprising.

Many of Canada's largest industrial plants (firms that want the best of everything) are our steady customers.

Order your next belt from D. K. McLaren and you'll never buy elsewhere again.

D·K·McLAREN
LIMITED

HEAD OFFICE AND FACTORY:
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ENGINEERS SUPPLY CO., 123 Bannatyne Avenue East, Winnipeg, Man.

TRADE MARK

TRADE MARK

HOSTS OF MAGNOLIA USES ARE SATISFIED AND GRATEFUL

Magnolia Metal Co.,

SIMON SOUND,
June 19th, 1916.

Dear Sirs:—

I am writing you once more to tell you of the satisfaction and pleasure I have in the use of Your MAGNOLIA METAL. It is almost wonderful what that stuff will stand. I have not taken a cap off a bearing or taken down a crank since I poured it, and I have done more work with higher steam pressures than ever I could do before, and when a person's livelihood depends on the work he does, he will then understand better the gratitude I am trying to express to the MAGNOLIA METAL people.

Yours truly,
CHARLES REYNOLDS.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c. post paid.

Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

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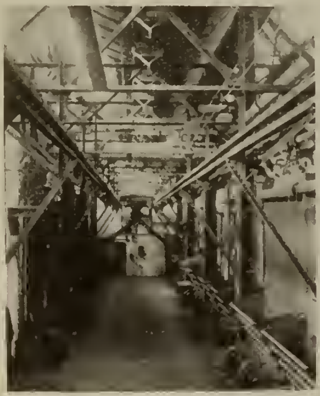
OFFICE AND FACTORY:
225 St. Ambroise St. MONTREAL



$1,250 is Saved Each Month

in the new power house of the Riverside & Dan River Cotton Mills shown here. This was accomplished by installing modern coal handling equipment among which is the Brownhoist Concrete Coal Bin. The cost with the old system was $58.50 every 24 hours and with the new system the cost is $17.00. This makes a saving of $41.50 each day.

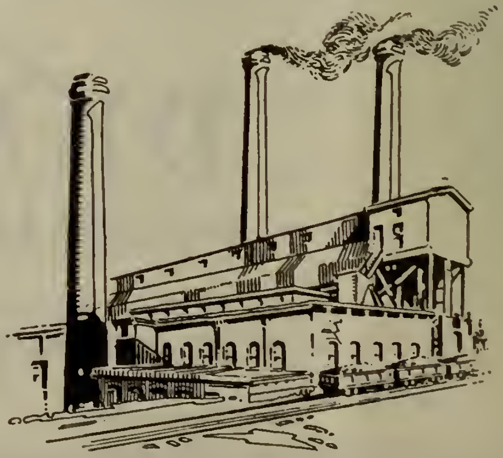
THE BROWN HOISTING MACHINERY COMPANY
CLEVELAND, OHIO

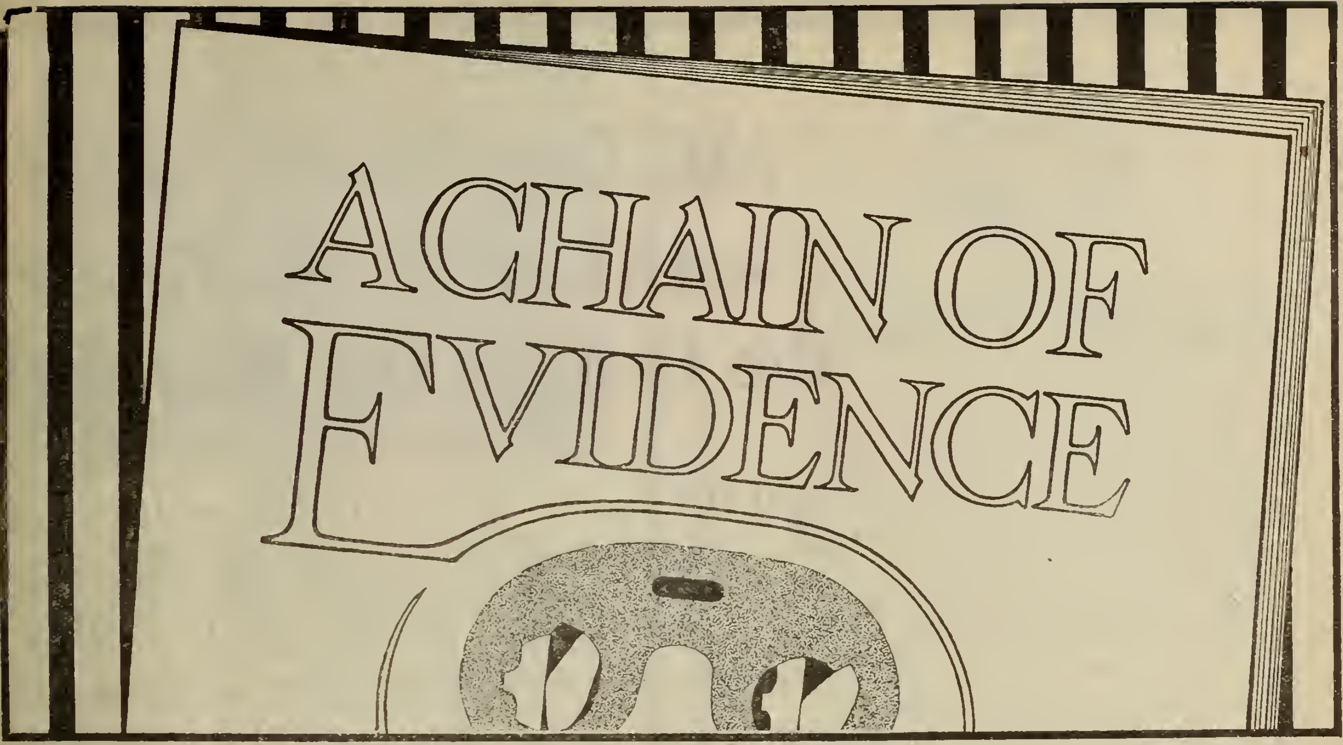
Branch Offices in New York, Pittsburgh, Chicago, San Francisco, Montreal and (Portland, Ore., Colby Eng. Co.)

BROWNHOIST
Concrete Coal Bin

as used in this plant is lined both inside and out with concrete. This prevents any corrosion of the steel and the bin will last as long as the plant and require no repairs.

Write for Catalog S





Write us today for a FREE COPY

If you use power at all, you will be interested in our Publication, No. 15

Small Power Drives

OUR business has been built up largely on the foundation of service rendered by "small power drives." With 1,500,000 horsepower of Morse "Rocker-Joint" Silent Chains now in use, imagine for a moment the thousands of different applications. They have entered practically every power-using industry, from A to Z, and everywhere have given the same uniform economical service, meeting our own expectations and satisfying our customers.

Get a copy of this bulletin and look around your shop or factory and see where a more quiet drive would be welcome, where a more efficient drive would add considerably to your production, or where a little space could be more advantageously utilized. Then think how well a chain drive,—"Morse, of Course,"—will meet your requirements.

Morse Chain Company, Ithaca, N. Y.

Morse Chain Co., Ithaca, N. Y.

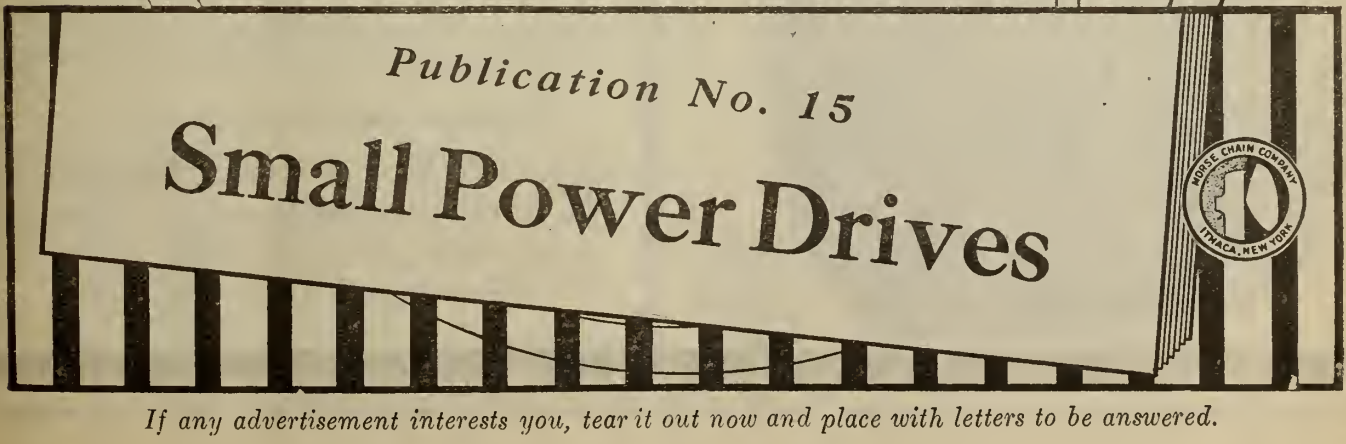
Please send me a free copy of your new publication, Number 15, A Chain of Evidence, devoted exclusively to "Small Power Drives."

Name__________

Company__________

Address__________

Power House, Nov. 1916.



If any advertisement interests you, tear it out now and place with letters to be answered.

AMERICAN Steel Split PULLEYS

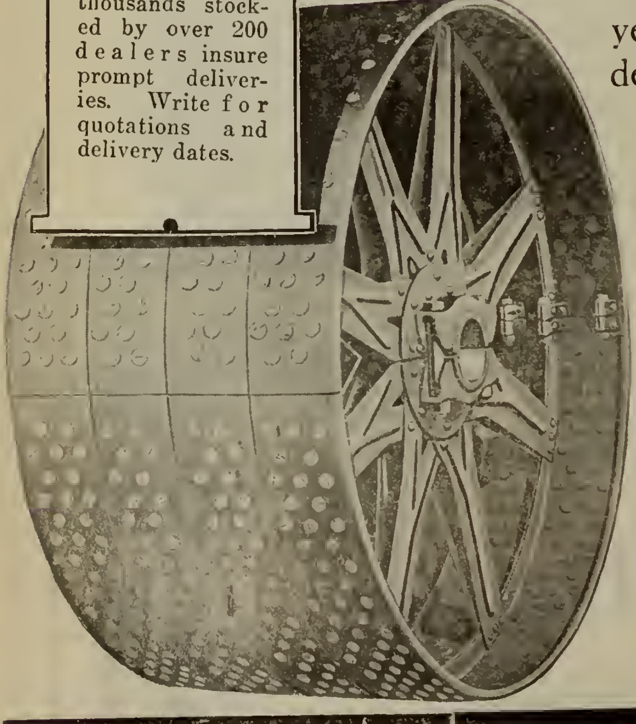
—with Cork Insets Tighten the Grip of the Main Belt

THIS cork inset pulley—in every other respect exactly like the standard "American" Steel Split Pulley—insures absolute belt grip at that "one time out of a thousand" when other pulleys *might* slip.

It is made to take the load of the main drive belt and transmit *all of it*. So the cork insets are put in. They *hold* the belt. Belt slip is reduced to a negligible factor.

The insets will wear almost as long as the pulley.

These pulleys have been on the market several years and have given splendid satisfaction. They deliver the power—with minimum loss.



Over 60,000 pulleys—3 in. to 120 ins. in diameter—stocked in factory, warehouse and branches, and additional thousands stocked by over 200 dealers insure prompt deliveries. Write for quotations and delivery dates.

American Pulley Company
4234-60 Wissahickon Ave., Philadelphia, U.S.A.

NEW YORK—
33-35 Greene Street.

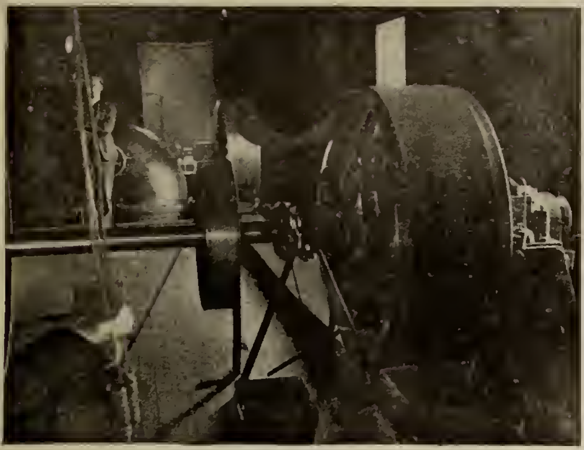
BOSTON—
165 Pearl Street.

CHICAGO—
114-116 S. Clinton Street.

SEATTLE—
536 First Ave., South.

Canadian Representatives:

Williams & Wilson, Limited, Montreal;
The A. R. Williams Machinery Co., Limited,
St. John, N.B., Toronto,
Winnipeg, Vancouver.



27 Cents per Year for CLING-SURFACE has kept this 10-in. Double Leather Belt highly efficient in night and day service for over 15 years.

Mr. T. F. Horan, Chief Engineer of Ludlow (Vt.) Electric Lt. & Pr. Plant, speaks as follows about the above and another belt long treated with Cling-Surface:

> *"Save for the 8 hours we shut down every Sunday, my 10 in. and 12 in. double-ply leather belts have run day and night since April 1st, 1901. They are in the best of condition to-day. Nothing has ever been used on any of my belts but Cling-Surface. No sign of wear whatever and they sag beautifully. The more load the belts pull, the more they sag, but they never slip."*

Four years ago we cited the belt shown as an evidence of the satisfaction and low cost of Cling-Surface treatment. Time has made no changes. Belts in this plant continue to receive systematic applications of Cling-Surface and now run better than ever.

Slack or easy-running of Cling-Surface-treated belts invariably produces labor and material savings and promotes continuity of operation in any plant. The Cling-Surface effects big economies **within the belt**, by penetrating, waterproofing and rejuvenating every fibre. It makes belts rugged and durable, and by preventing slip and permitting eased tensions on bearings, pulleys, hangers and shafts, makes improved conditions **outside** the belt that are of greater economy than those **inside.**

If your belts are tight, slipping, cracking, running off or wearing out—TELL US. One trial of CLING-SURFACE will immediately make you a Cling-Surface enthusiast. If not, you can have your money back. Send trial order TO-DAY or at least ask for literature.

Cling-Surface
the life preserver for belts

Cling-Surface Co
1057 Niagara Street
Buffalo NY

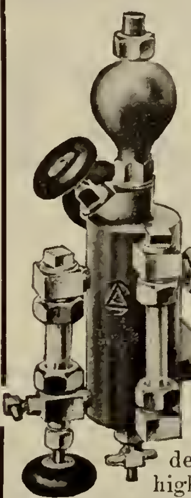
77

ALBANY GREASE

will show wonderful lubricating results on engines, motors, pumps, compressors, line shafting and all other kinds of machinery at all times. Albany Grease can be used in any kind or style of grease cup and will not cake or clog the cup. It will not leak or run away. No matter what kind of machinery you have, Albany Grease will lubricate it perfectly. Why not try Albany Grease at our expense? We'll send a quantity and a cup if you will write.

Your dealer sells Albany Grease; if not, order direct

Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868



Detroit Lubricators Meet Demands of Every Kind of Service

They are scientifically designed in a sufficient variety of styles and kinds to properly lubricate the valves and cylinders of all types of steam engines, steam pumps, gas engines, air compressors, etc.

The greatest care is given to all details of manufacture to insure uniformly high efficiency. They provide constant, evenly regulated and economical lubrication. There is nothing of the "hit or miss" about them. Send for our catalog L1 to-day. It contains much valuable information upon lubricating devices and will be sent upon request.

THEIR efficiency holds over half the world's trade.

Makers of the Stewart Carburetors.

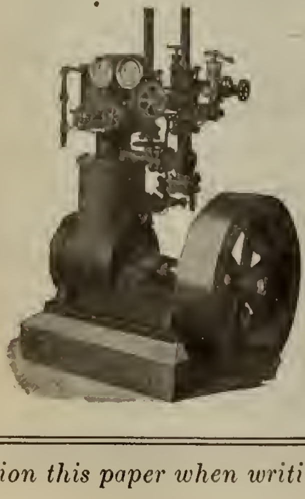
CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

THE
LINDE CANADIAN REFRIGERATION
COMPANY, LIMITED

Montreal, 37 St. Peter Street

TORONTO WINNIPEG CALGARY EDMONTON VANCOUVER

Makers of Quality Machinery in Canada since 1896



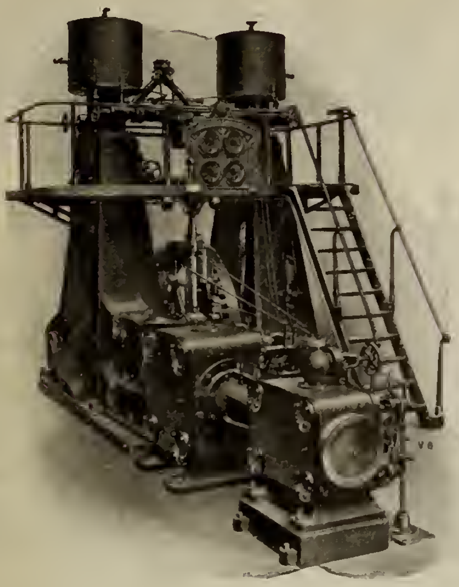
Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones. AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Corliss Engines *Special Machinery*

THE VILTER MANUFACTURING COMPANY
242 Beecher Street, MILWAUKEE, Wis. *Chicago Office:* 731 Monadnock Building



Why not operate your Plant with the highest efficiency and economy?

Write us advising what you have been doing and what additions you have contemplated.

Our Engineering corps will advise you impartially the best type of Plant for you to install and what you will need to reach the highest efficiency and lowest costs.

Get our new Fitting Catalog.

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:
THE FRICK ICE AND REFRIGERATION COMPANY, 357 St. Catherine Street West, Montreal

DOORS

For Cold Storage and Freezer Purposes Either Standard or Fireproof

JAMISON'S "JONES" and "NOEQUAL" doors are SUPERIOR because:

1st—Only the best materials are used in their construction.
2nd—We use heavier materials, Result: Longer life and increased efficiency.
3rd—Our doors are built with double and triple seals of contact—others have but one.
4th—Our Automatic Self-Tightening Fastener is the only truly AUTOMATIC and SELF-TIGHTENING Fastener on the market.
5th—Our ADJUSTABLE SPRING Hinges mean the door is always properly seated in the frame, making sagging impossible.

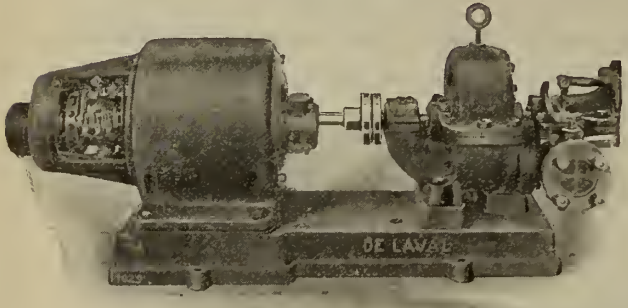
Write for General Catalog No. 7, illustrating and describing both "Jones" and "Noequal" doors, windows, ice doors and chutes, etc.

Jamison Cold Storage Door Company

Formerly Jones Cold Store Door Co. HAGERSTOWN, MD., U.S.A.

DE LAVAL

Small Direct-Current Generators



De Laval Directly Connected Turbine-driven Auxiliary Generating Set; 10 Kw.

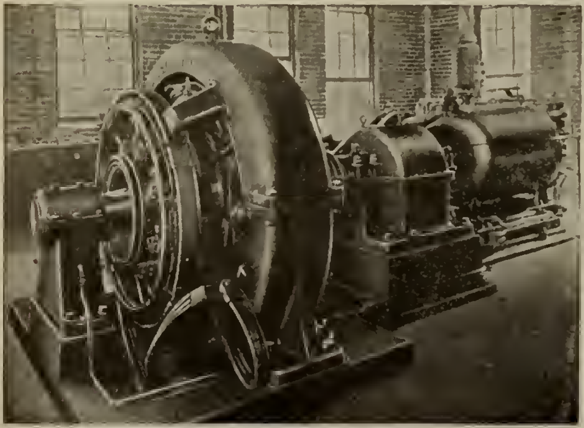
Can be coupled directly to the steam turbine. For larger units we recommend the use of the De Laval Double-helical Speed-reducing Gear. By using turbine-driven direct-current generators all complications, trouble and expense inherent in engine-driven generators or rotary converter sets are eliminated. The unit requires little attention, other than to see that the oil wells are kept filled, and can be started and stopped like an ordinary motor. The turbine can be adapted to meet any steam conditions.

State requirements and Publication B 61 will be sent.

DE LAVAL STEAM TURBINE COMPANY
TRENTON, N. J.

TURBINE EQUIPMENT CO., LIMITED, Canadian Pacific Bldg.
Canada.
THE E. LAURIE CO., 243 Bleury Street, MONTREAL, Que.

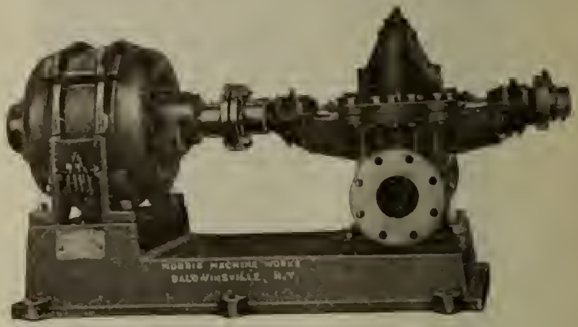
Something For Nothing



THE unit illustrated generates 300 k.w., using exhaust steam from Corliss engines, burning no extra fuel. Operates 24 hours per day, six days a week. Installed at the plant of the Columbia Plate Glass Co., Blairsville, Pa. *Write to-day for Bulletin 53.*

Kerr Turbine Co., Wellsville, N.Y.
OFFICES IN ALL LARGE CITIES

Morris Pumps

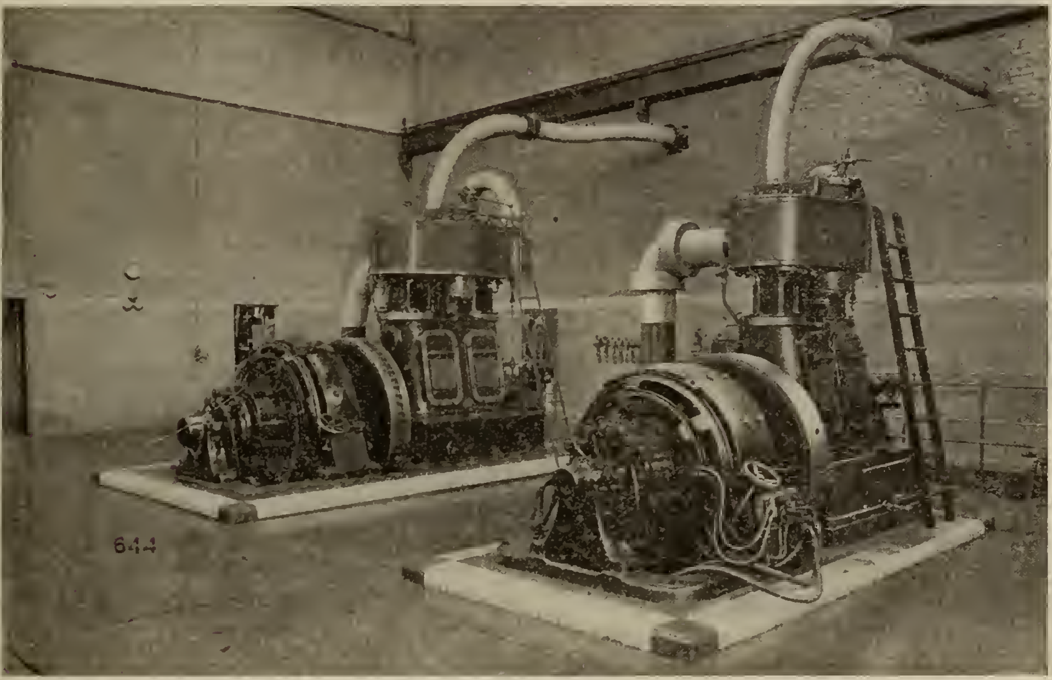


The horizontal shaft double suction pump illustrated above was designed to meet the demand for a high efficiency pump. It is also built multi-stage in sizes from 2" to 20" discharge.

Our 126 PAGE MORRIS BOOK is free. Better send for it—To-day.

Morris Machine Works Baldwinsville, N.Y., U.S.A.
Builders of Centrifugal Pumps, Hydraulic Dredges, Steam Engines
Canadian Sales Agents:
Storey Pump & Equipment Co., Toronto, Can.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Engines installed in McGill University Power House
Total Horse Power, 1010 B.H.P.

We have for immediate delivery several Engine Generator Sets. Write for Particulars.

Send Us Your Enquiries For

Steam Engines
Gas Engines
Oil Engines
Diesel Engines
Steam Turbines
Air Compressors
Condensing Plant
Centrifugal Pumps
Boiler Feed Pumps
Water Wheels
Water Meters
Hydraulic Presses
Hydraulic Pumps
Hydraulic Accumulators
Pressure Filters
Gravity Filters
Water Softening Plants
Refuse Destructors
Activated Sludge Sewage Disposal Plants

Complete Power Plants Designed and Erected.

LAURIE & LAMB

Engineers

211 Board of Trade Bldg. :-: :-: MONTREAL

YORK

NATURALLY we are enthusiastic about YORK Refrigerating Equipment. We know how good it is in Design, Material and Workmanship—and what it will do.

This knowledge is rapidly spreading over the entire field, as we are constantly adding new patrons as a result of the excellent performance of YORK Plants in actual service.

Those who contemplate the use of Mechanical Refrigeration for any purpose, our Engineering Department can help in the preliminary steps.

The complete YORK line offers greater value for a given investment than can be obtained elsewhere.

With YORK SERVICE back of a YORK Plant, the Owner can feel sure that he has safeguarded his every interest.

Therefore a YORK PLANT *is the logical one to buy.*

THINK IT OVER

Represented in the Dominion by
Canadian Ice Machine Company
MONTREAL - - - 626 Coristine Building
TORONTO - - - - 82 Chestnut Street
WINNIPEG - - - - 85 Lombard Street

York Manufacturing Company
(Ice-Making and Refrigerating Machinery exclusively)
YORK, PA., U. S. A.

Why is a Moisture-Proof Covering Better?

Because it will last almost indefinitely and retains its insulating efficiency to the end.

Just take a look at this piece of Nonpareil Cork Covering. It was installed on a brine line in 1900, and removed 15 years later. Even then it was in excellent condition and was only taken off because repairs were necessary.

The remarkable service that

Nonpareil Cork Covering
For All Cold Pipes

gives, is due almost entirely to its ability to resist moisture. In the first place, the clean, granulated cork, of which it is composed, does not suck in moisture by capillary attraction; second, each cork granule is coated with the natural waterproof gum of the cork by the manufacturing process; third, as a further protection the covering is coated inside and out with a mineral rubber finish, and all joints are sealed with waterproof cement. Hence, Nonpareil Cork Covering keeps dry and retains its insulating efficiency almost indefinitely.

Nonpareil Cork Covering after 15 years' service on a brine line at Duquesne Garden, Pa.

A 64-page book and sample of Nonpareil Cork Covering will be sent, free of charge, on request.

Armstrong Cork & Insulation Co., Ltd., 504 McGill Bldg. Montreal, Que.
Also manufacturers of Nonpareil Corkboard for cold storage rooms and Nonpareil High Pressure Covering for steam lines.

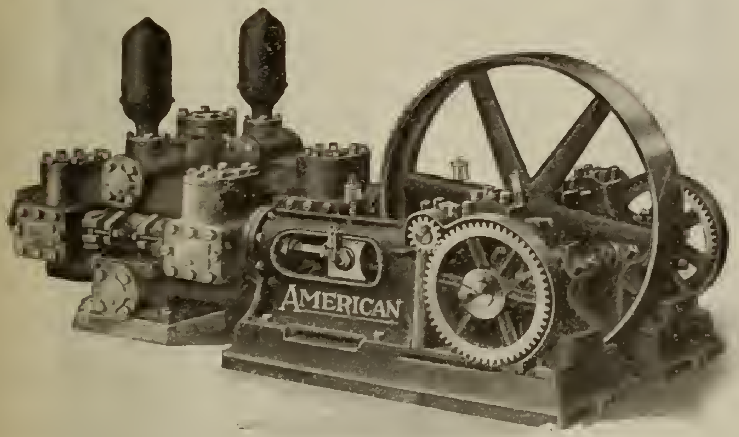
If any advertisement interests you, tear it out now and place with letters to be answered.

MARSH and AMERICAN

Pumping Machinery. Steam and Power Driven

The world has used and endorsed over 130,000 Marsh and American Pumps. Twenty-seven years of pump manufacture have proved our ability and perfected our facilities. Marsh and American Pumps are 100 per cent. correct—from the selection of raw material and accuracy of design to the actual pumping service, day in and day out, year after year. They ask no apologies and never have to explain away any error in service or failure in efficiency.

Investigate. Ask for our 250-page catalog illustrating and describing the line. Your pumping problems will be answered fully and satisfactorily through this investigation. This catalog will be sent by return mail in answer to your inquiry. Your copy is awaiting your prompt request.



American Duplex Belt-Driven Boiler Feed Pump. Outside Packed Plunger Pattern.

AMERICAN STEAM PUMP COMPANY

BATTLE CREEK, MICH.

CANADIAN AGENTS:

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.

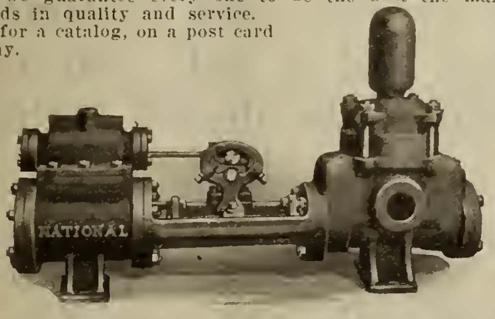
The Balanced Piston Valve

Simplifies the steam chest construction, eliminates the slide valves, and gives better steam economy. The valve is fitted with snap rings to provide for wear.

NATIONAL STEAM PUMPS

National Pumps are made from the best materials under most careful construction, and embody the latest and best designs known to modern engineering.

THERE'S a National Pump to fill your every requirement and we guarantee every one to be the best the market affords in quality and service.
Ask for a catalog, on a post card to-day.



"NATIONAL" Boiler Feed Pump

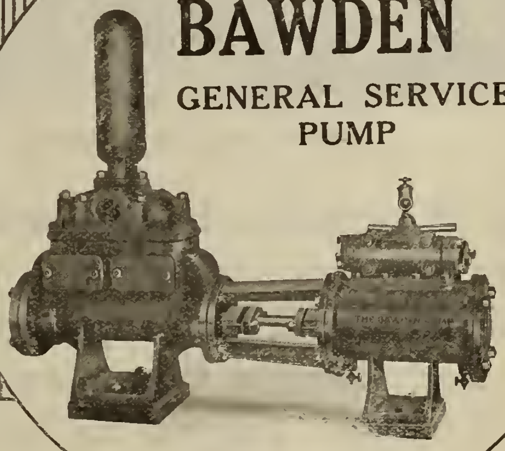
National Steam Pump Co.

Upper Sandusky, Ohio

BAWDEN NEVER SHORT STROKE PUMPS

BAWDEN

GENERAL SERVICE PUMP



NO Tappets. NO External Valve Gear Levers or Springs. NO Internal Tubes or Stuffing Glands.
Construction is of very best throughout.
The Steam Cylinders are designed to withstand modern pressures. They are fitted with cast iron block pistons, self-adjusting cast iron rings and steel rods. Water cylinders are of suitable strength for pressures not exceeding 100 lbs. per square inch.

Drop a card for full particulars.

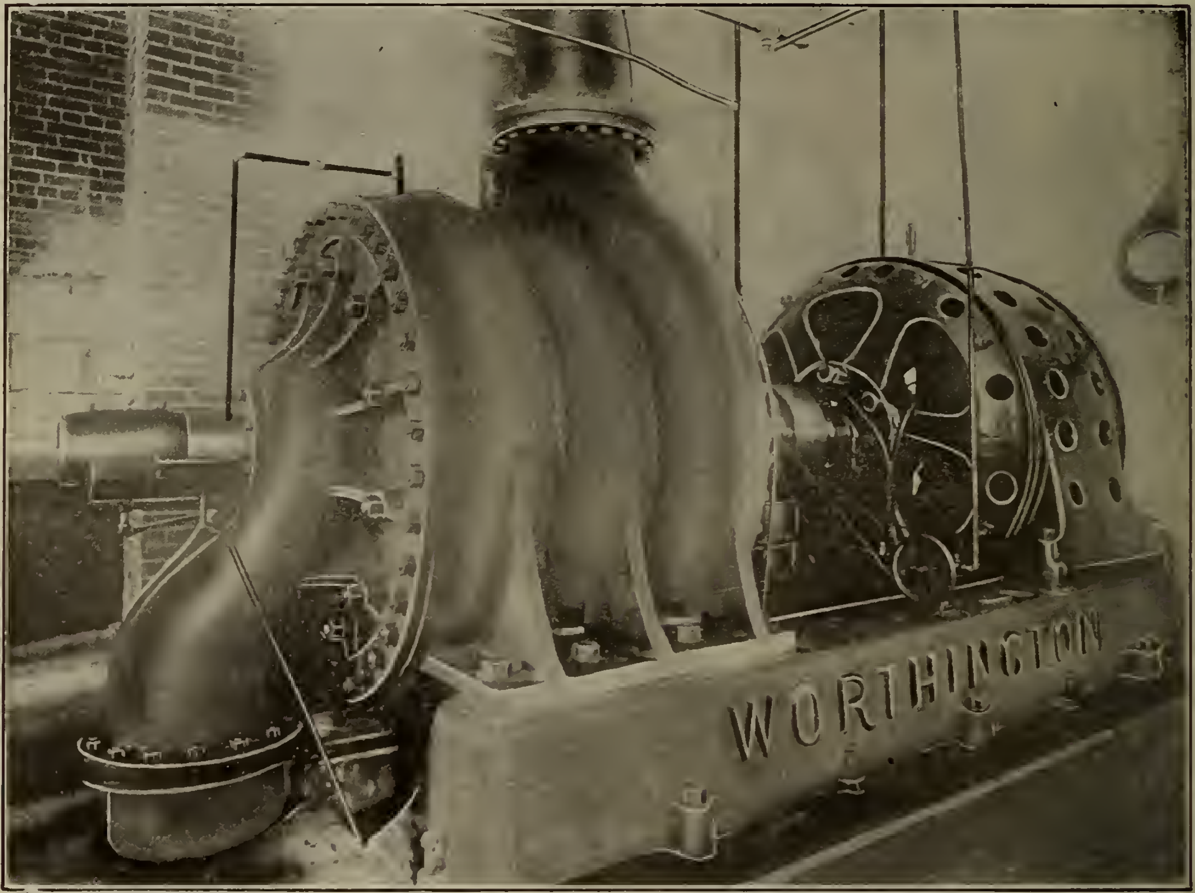
THE BAWDEN MACHINE CO., LIMITED

133 STERLING ROAD, TORONTO, CANADA

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works : Seigneurs and William Streets, MONTREAL



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The Publisher's Page

TORONTO November, 1916

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(No. 1 of a Series of Short Articles)

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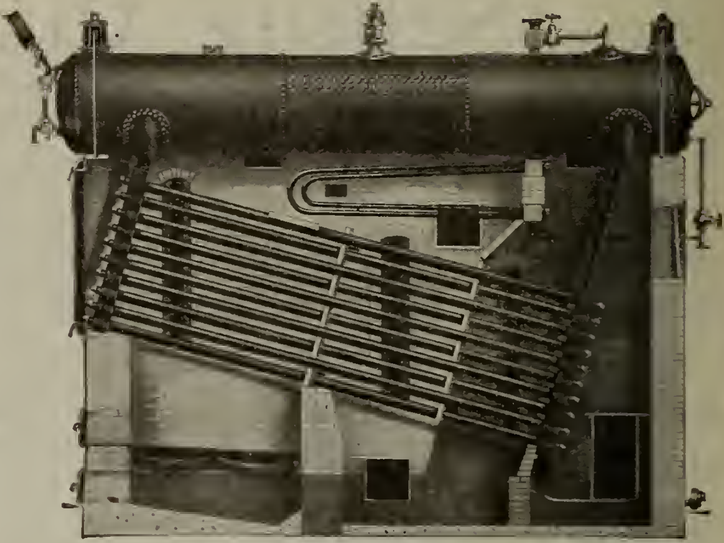

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POWER EQUIPMENT

is the solution to your Power troubles. Our Engines, Boilers, Heaters, Pumps, etc., are designed and built with one object in view, namely: Quality and satisfied users. Among our various types there is sure to be one that will meet your own particular requirements.

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FIG. 1.—MAIN BUILDING OF TEE UNIVERSITY OF TORONTO, NORTH OF AND FACING THE CAMPUS.

Central Heating and Power Plant, University of Toronto

By L. M. Arkley, A.M. Can. Soc. C.E. *

The operation of central heating plants for the supply and distribution of heat over comparatively large areas has been successfully accomplished in certain instances by progressive municipalities. The private installation of such systems, however, is somewhat infrequent, due probably to absence of opportunity. Such an enterprise as that featured in the present article possesses exceptional interest not only because of magnitude and distances involved, but because of the consistent results which are justifying the wisdom of the undertaking.

THE buildings which comprise the University of Toronto are situated in extensive grounds, on west side of Queen's Park, in the city of Toronto. Bounded on the north by Bloor street, the west by St. George street, and the south by College street, the 21 buildings, as shown in plan, Fig. 5, present a problem of considerable magnitude and interest as regards the provision of a suitable heating system.

Previous to the year 1911-12, the widely scattered buildings were heated by several separate plants, the most of which were old and inefficient. Electric current for light and power was partly generated in these plants and partly purchased from supply companies. Conditions, therefore, were such that the possible economies which could be effected through the installation of a central heating and power plant warranted such a procedure, and the gradual reduction of costs since the plant was started are submitted hereunder as justifying the centralization of the heating and lighting plants.

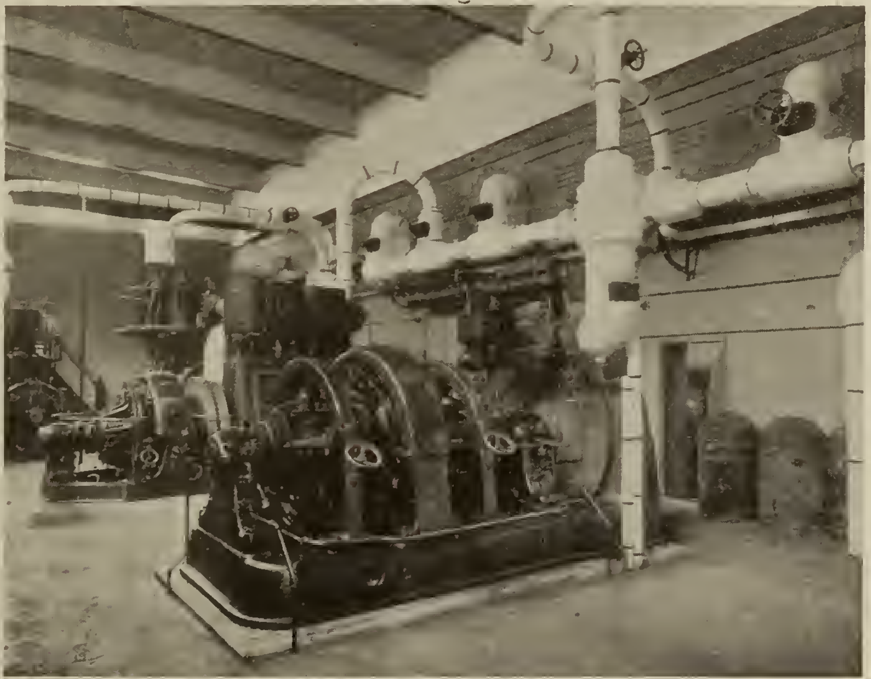

FIG. 2—INTERIOR OF POWER HOUSE ENGINE ROOM SHOWING CURTIS TURBO-GENERATOR IN FOREGROUND WITH ALLEN HIGH SPEED UNIT IN REAR

Power House

The location selected for the central plant was to the east of the Medical Building (4), and adjacent to the western end of the Ontario Legislative Building in Queen's Park. The power house building is for the most part underground, its flat roof being practically level with the pavement in the adjacent driveway in the park, from which the ground slopes down so that the west wall of the building is about eight or ten feet above ground level.

The main object in providing such a location was to facilitate the installation of a gravity return heating system. An additional, though minor advantage, was that it has been possible, by placing ornamental balustrades on roof of the coal bunkers, and the judicious planting of shrubbery, to almost entirely disguise the location of the plant so that the scenic surroundings of the Legislative Building suffer no detraction whatever.

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*Assistant Professor of Mechanical Engineering, University of Toronto.

FIG. 3—KNOX COLLEGE. THIS EDIFICE ALSO FACES THE CAMPUS, AND IS ONE OF SEVERAL RECENTLY COMPLETED BUILDINGS

The ground space occupied by the building including the coal bunkers, is 82 feet in length by 107 feet in width. The sectional view, Fig. 7, shows the relative position of the engine room, boiler room and coal bunkers. The boiler room is 58 feet wide, with a total height of 26 feet and contains four Babcock and Wilcox water tube boilers, each of 403 nominal horse-power, and one boiler of the same make with a rating of 516 horse-power, giving a total of 2,128 boiler horse-power.

All of the boilers operate at a pressure of 150 lbs. per sq. in., without superheat, and each unit is equipped with a Murphy automatic smokeless furnace to which coal is fed by gravity from the overhead bunkers. These have a capacity of 600 tons, are built of concrete, and, as shown in Fig. 7, overlap the furnaces so that a suitable angle is obtained for the delivery pipes which are fitted with sluice valves at their upper end for regulating the supply of coal. The bunker is 25 ft. wide and 12 ft. high, and the roof forms part of the roadway by which the coal is brought to the plant, the sidewalk, along with the balustrades referred to, being indicated thereon.

An induced draft system is operated in conjunction with the boilers—two 78-in. American Blower Co. fans coupled to Robb fan engines drawing the waste gases from a smoke breeching extending along the back of the boilers (see Figs. 6, 8, and 10), and discharging them into an underground concrete tunnel leading to a brick stack which is built into a corner of the Medical Building (4).

Boiler feed requirements are taken

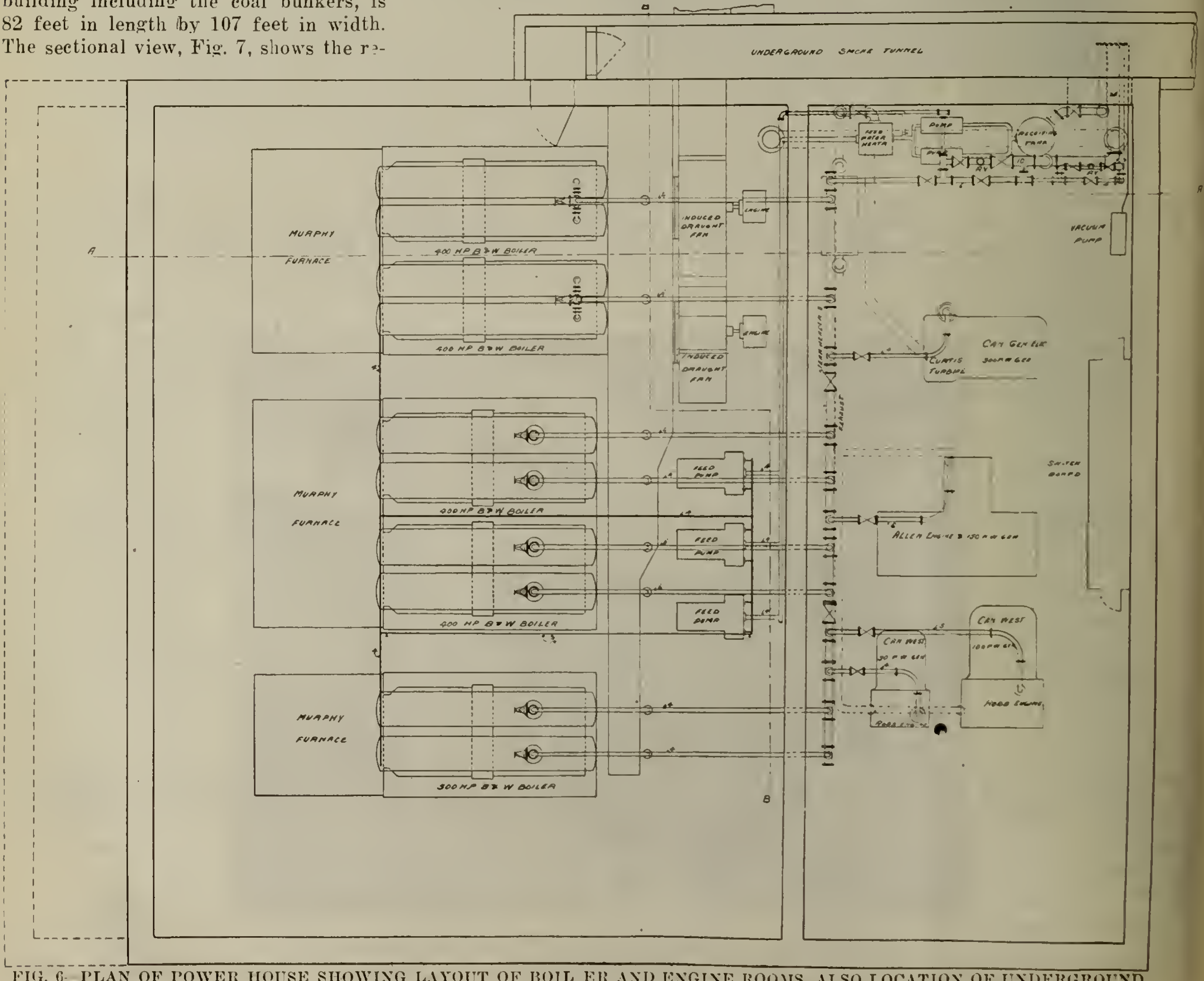

FIG. 6—PLAN OF POWER HOUSE SHOWING LAYOUT OF BOILER AND ENGINE ROOMS, ALSO LOCATION OF UNDERGROUND SMOKE TUNNEL

FIG. 4—DEPARTMENT OF HOUSEHOLD SCIENCE BUILDING, SITUATED ABOUT ONE MILE FROM THE CENTRAL HEATING PLANT

care of by an installation of three Smart-Turner duplex steam-driven feed pumps. These are illustrated in Figs. 10 and 11, and are of the outside end-packed plunger type, 10 in. x 6 in. x 10 in., with pot valves. They are situated immediately behind the boilers, and are so piped that two independent methods are available for supplying water to the boilers. At the near end of the pump room, Fig. 10, is the hot well, equipped with two small steam pumps for draining purposes, and one Bundy steam trap for taking care of the high pressure drips.

The coal used is a bituminous slack containing about 21 per cent. of volatile matter and this is burned with very little smoke. While the coal is not bought on the B. T. U. basis, samples are taken regularly from the delivery waggons and tested for ash , volatile matter, carbon, moisture and sulphur. This procedure has resulted in the quality of coal received being uniformly high.

Engine Room

The engine room extends the full length of the building, i.e., 82 ft., and is 30 ft. wide by 23 ft. high, the floor level being 3 ft. above that of the boiler room. It is separated from the boiler room by a 27-in. brick wall, and although not shown, a hand-operated overhead traveling crane is provided, fitted with a 3-ton Yale triplex block, which enables all maintenance adjustments and repairs to be conveniently made.

The equipment contained in the engine room consists of four steam-driven generating units, switchboard, waterweigher and feed water heater, with feed water and vacuum pumps, the purpose of the latter being explained under heating section.

The generators are all direct connected to their engines, and are as follows:

One horizontal Curtis steam turbine, driving a 300 kw. General Electric D. C. generator, running at 1,500 rev. per min. (see Fig. 2).

One high speed vertical compound reciprocating engine, with generator built by W. H. Allen, Son & Co., Bedford, Eng., cylinders 16 in. and 24 in. x 11 in. stroke, developing 300 kw. at 400 revs. per min. This unit can be seen behind the Curtis outfit in Fig. 2.

Two Robb, Armstrong-Westinghouse units of 100 kw. and 50 kw. capacity respectively—these engines are of the single cylinder vertical type, the former having a 15 in. x 14 in. cylinder, and speed of 275 revs. per min., and the latter a 12 in. x 10 in. cylinder, with a speed of 265 revs. per min., shown in Fig. 12.

All of the engines operate under a steam pressure of 140 lbs. per sq. in. at the throttle, while the generators supply direct current at a pressure of 110 volts, each unit having an individual panel on the switchboard, which has seven panels in all, two being for distribution purposes and the seventh coupled up to one of the local supply companies.

The auxiliary apparatus in the engine

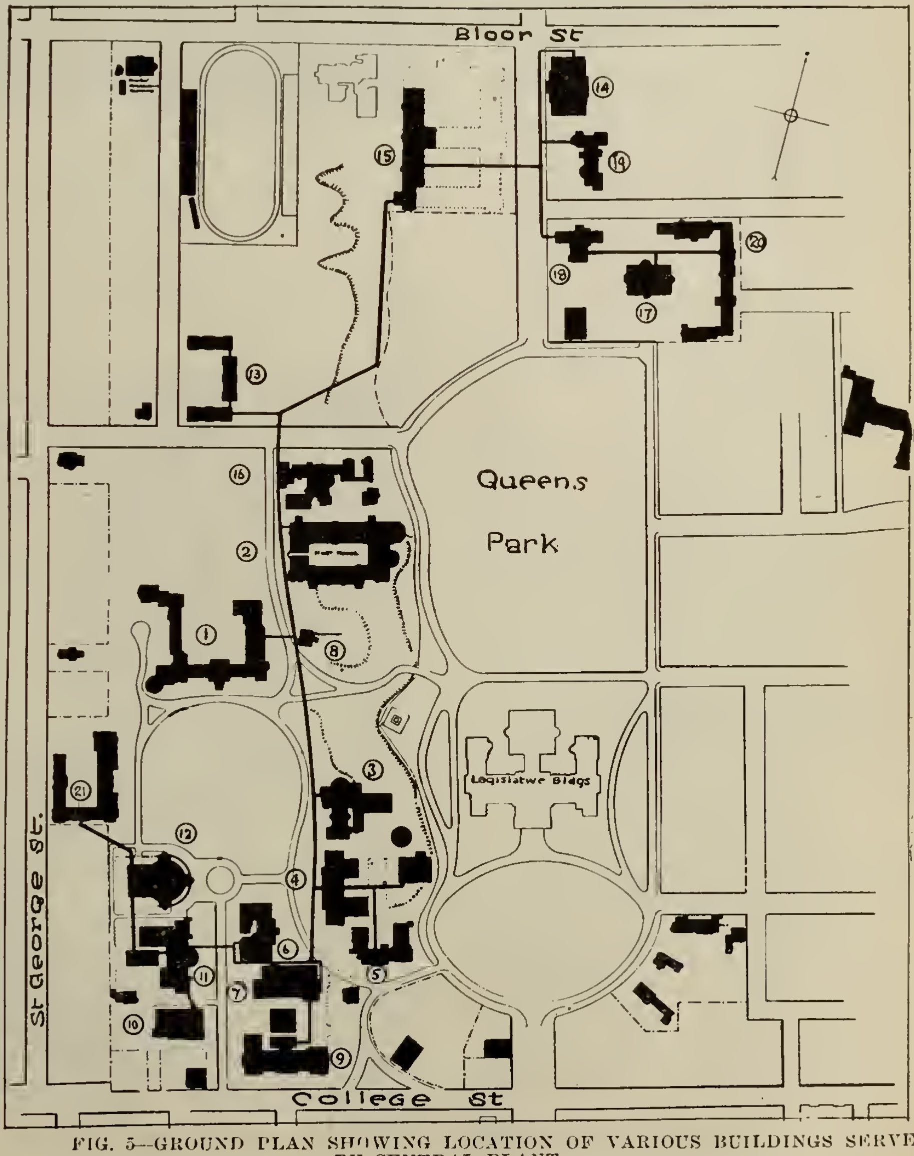

FIG. 5—GROUND PLAN SHOWING LOCATION OF VARIOUS BUILDINGS SERVED BY CENTRAL PLANT

room is illustrated in Fig. 13. At the left of the photograph is a Webster open type feed water heater, which receives part of the exhaust steam from the generating units, and is supplied with feed water by two Smart-Turner 6 in. x 5¾ in. x 6 in. duplex pumps, located next to it. Further to the right is a Kennicott water weigher with a maximum capacity of 65,000 lbs. per hr.

Immediately above the water weigher is the entrance to the tunnel which carries the distributing pipes and cables referred to later, the 20 in. main being clearly discernible as it enters. At the extreme right is an 8-in. x 12-in. x 12-in. Warren vacuum pump, referred to above.

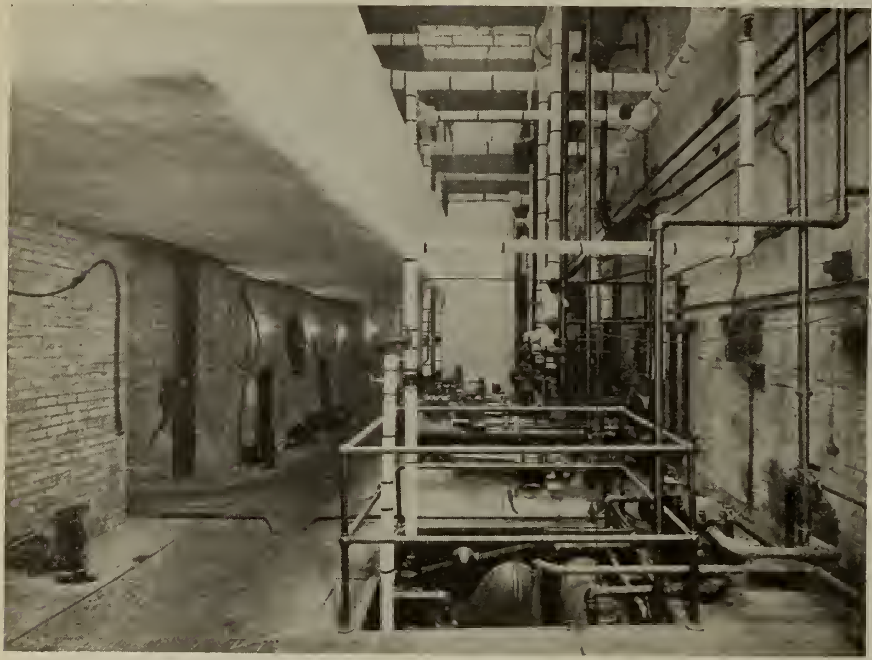

FIG. 10—PUMP ROOM SHOWING ALSO SMOKE BREECHING IN UPPER LEFT HAND CORNER AND FAN CASINGS IN BACKGROUND. HOT WELL IS IN IMMEDIATE FOREGROUND

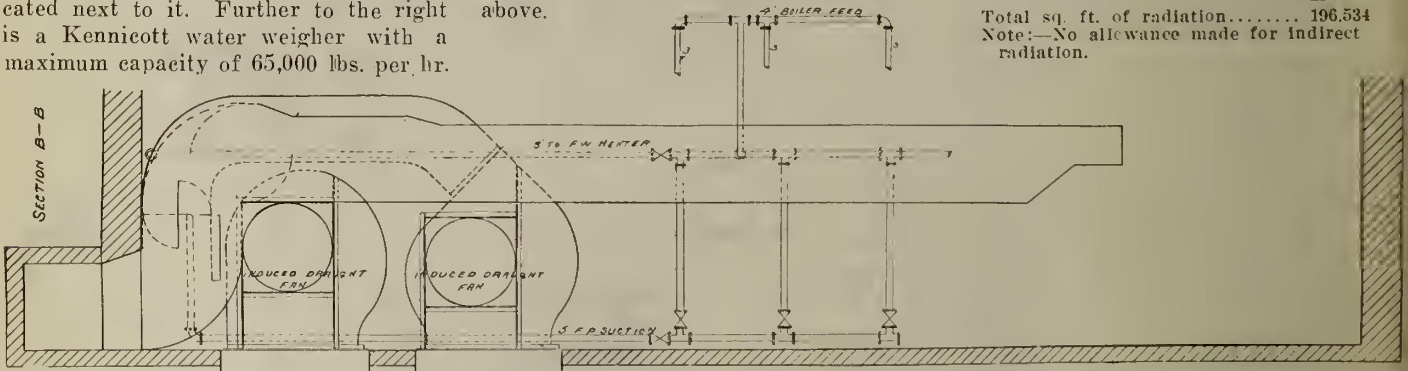

FIG. 8—ELEVATION OF INDUCED DRAUGHT EQUIPMENT SHOWING SMOKE BREECHING, FAN CASINGS AND SECTION OF SMOKE TUNNEL

Heating System

The heating system was originally designed as a gravity return system, the hot well in the power house being the low point to which all condensed steam returned by gravity. Of the original buildings heated in this way, the Main and Mining Buildings have been changed to a low pressure or vacuum system and the same method has been adopted for the recently completed Knox College and for Hart House. In this case the vacuum pumps located in these buildings discharge the returns from the radiation to overhead tanks, from which it flows by gravity into the main return line back to the power house.

The following table gives a list of the buildings heated, together with the number of square feet of radiation in each for the heating season 1914-15:—

Name and No. of Building.	No. of sq. ft. of Radiation.
No. 1—Main	12,936
No. 2—Hart House (in course of construction)	5,000
No. 3—Library	10,829
No. 4—Medical	7,160
No. 5—Biological	8,271
No. 6—Engineering	9,084
No. 7—Thermodynamics	6,114
No. 8—Observatory	783
No. 9—Mining	12,721
No. 10—Chemical	6,595
No. 11—Physics	19,648
No. 12—Convocation Hall	6,689
No. 13—Men's Residences	9,336
No. 14—Household Science	10.137
No. 15—Museum	17,303
No. 16—Wycliffe College	12,371
No. 17—Victoria College	9.028
No. 18—Victoria College (Library).	4,021
No. 19—Annesley Hall	4,274
No. 20—Burwash Hall	4,300
No. 21—Knox College (not completed	15,000
Total sq. ft. of radiation	196.534

Note:—No allowance made for indirect radiation.

Piping Distribution System

The main heating pipe as it leaves the power house is 20 in. dia., and con-

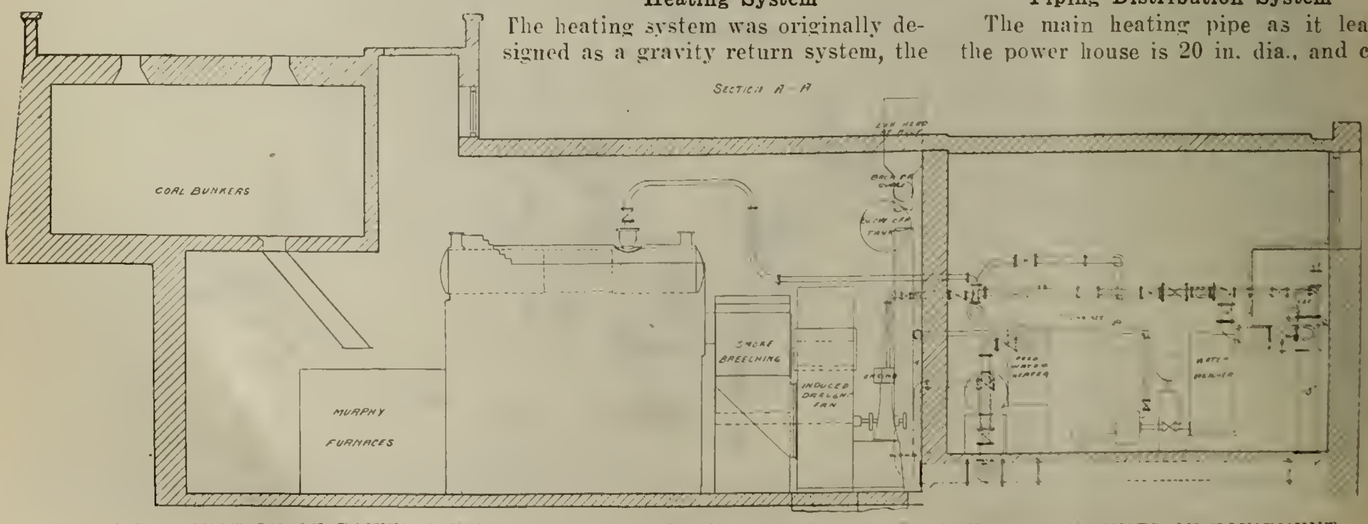

FIG. 7—SECTION OF POWER HOUSE BUILDING SHOWING ELEVATIONS OF THE VARIOUS UNITS OF EQUIPMENT

tinues of this size to a point west of the Medical Building (4), where it branches north and south in 16 in. mains, and gradually reduces in size towards the end of the line.

All engines, turbines and steam pumps in the power house exhaust into this pipe, but as the lighting and power load is normally small compared with the heating load required, live steam is introduced by passing it through a pressure reducing valve in the usual way. A pressure of from one to 4 lbs. per sq. in. is carried on the main heating pipe at the power house.

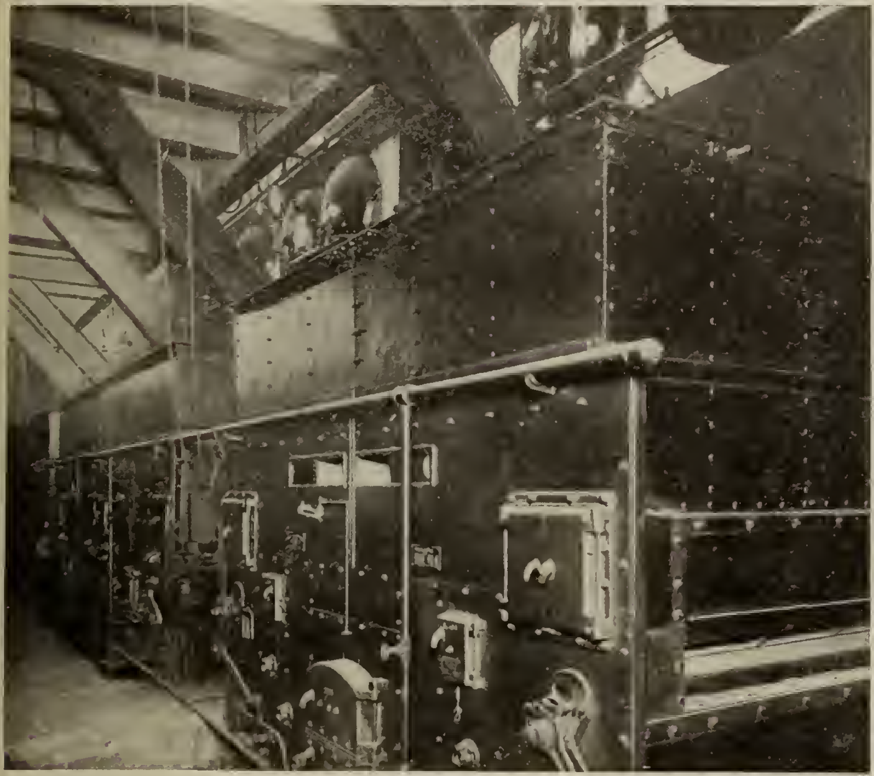

FIG. 9.—BOILER ROOM SHOWING MURPHY FURNACE INSTALLATION.

The question of expansion and contraction due to change in temperature is an important one in a steam line of this length, and it is taken care of by slip expansion joints, the pipe being securely anchored at the proper points. This form of expansion gives satisfactory service if the pipe is looked after and kept well in line, otherwise it leaks.

A question of still greater importance than that of expansion is that of condensation of steam, as excessive condensation means not only a loss of heat, but also introduces the problem of taking care of the water of condensation. The best method of reducing the loss from this source is, of course, to lag the pipes well with some heat insulating material; this feature in the original layout was somewhat neglected resulting in a hot tunnel and large quantities of condensed steam in the main pipe, this condensation being drained from the pipe through traps to the power house. It was found necessary later to instal a vacuum pump in the power house to pump this condensation back and deliver it to the hot well, and with this addition the system works quite satisfactorily.

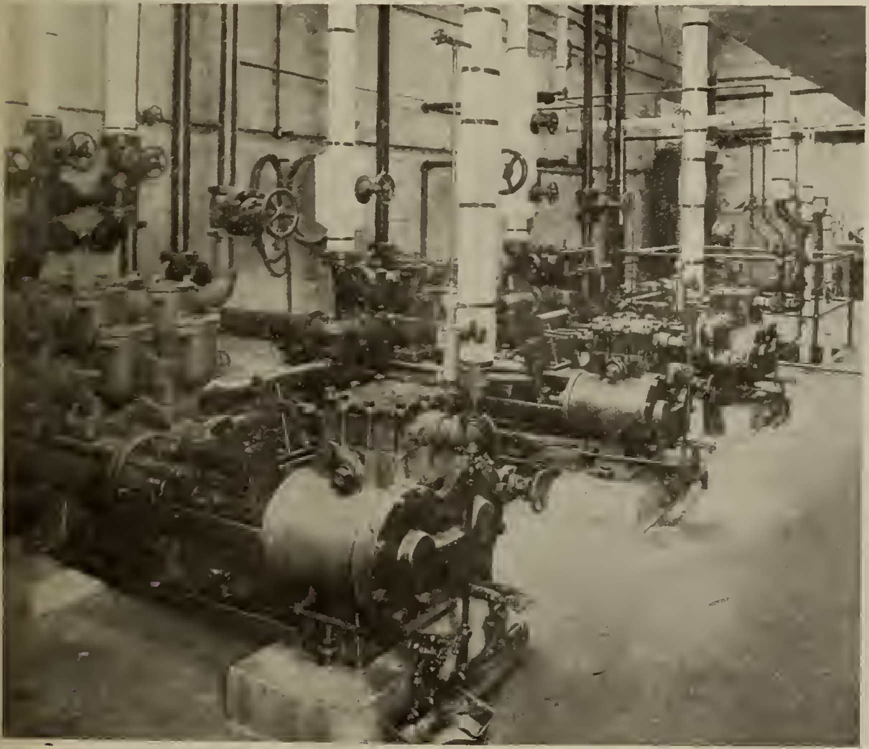

FIG. 11—THREE SMART-TURNER DUPLEX BOILER FEED PUMPS WITH OUTSIDE END-PACKED PLUNGERS AND POT VALVES.

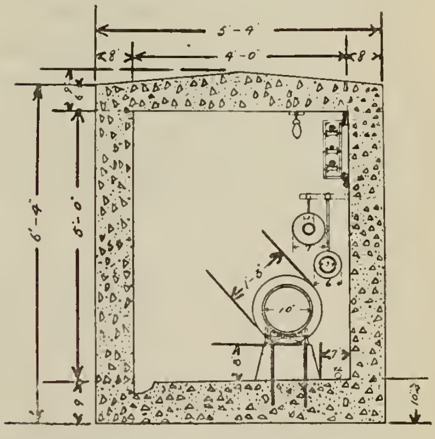

FIG. 14—SECTION OF TUNNEL CONNECTING KNOX COLLEGE WITH CONVOCATION HALL

Besides the main heating pipe, the tunnel contains a live steam main of 5 in. diameter, where it leaves the power house, also the main gravity return line of 8 in. diameter, and a 5 in. return line to the vacuum pump from the 20-in. main. The live steam is carried at 50 lbs. pressure and is used principally in the Main Building (1), Burwash Hall (20), Knox College (21), and the Household Science Building (14).

Besides these pipes all electric wires are carried on the walls of the tunnel.

Tunnel Construction

The main tunnel through which all steam pipes and electric wires are distributed to the various buildings, is of concrete and of 5 ft. x 6 ft., inside dimensions, where it leaves the power house. Its walls are vertical and 8 in. thick, while the roof slab slopes from 9 in. at the centre to 6 in. at the walls, and is reinforced where necessary.

The power house is indicated on Fig. 5 by a solid black circle.

Figure 14 shows a section of a piece of tunnel built recently by the Superintendent's Department to connect Knox College (21) with Convocation Hall (12). This shows a considerable improvement over the first tunnel built, in the arrangement of the piping and wiring. The main pipe rests on rollers which in turn ares upported by substantial concrete piers securely bolted at the bottom of the tunnel; this point requires attention or the gradual movement of the pipe due to expansion, will work the piers loose in a short time. this trouble having actually developed in the original layout. The plant has been remodeled in many respects since first installed and this work has been done under the supervision of A. D. LePan, Joint Superintendent of Buildings and Grounds, under whose direct supervision the plant is operated.

Efficiency Test of Boiler Plant

The object of the test was to find the efficiency of the boiler plant under actual working conditions. While the boilers were cleaned shortly before the test, there was no special preparation made to insure anything but a normal efficiency.

The test was conducted by the writer assisted by J. D. Thompson, Demonstrator in Mechanical Engineering, and the members of the 1916 graduating class. A. D. LePan, Joint Superintendent, and W. H. Bonus, of the Superintendent's office, gave every assistance in preparing for the test. The operation of the plant was under the direction of C. Moseley. The accompanying table embodies in its detail the various factors entering into the test, together with the obtained results.

1—Name of Plant	University of Toronto Heating and Lighting Plant
2—Number and kinds of boilers	Five Babcock and Wilcox water tube
3—Kind of furnace	Murphy Automatic
4—Grate Surface—Inclined grates—	
Projected area	328 sq. ft.
Actual area	454 sq. ft.
5—Heating surface— Total	21,264 sq. ft.
8—Date	Jan. 17th, 1916
9—Duration	11 hours
Average Pressures, Temperature, Etc.	
10—Kind and size of coal	Vinton, Slack
11—Steam pressure by gauge	153 lbs. per sq. inch
12—Steam pressure absolute	167.6 lbs. per sq. inch
13—Temperature of feed water entering boiler	173° F.
14—Temperature of escaping gas leaving boiler	487° F.
15—Force of draft between damper and boiler	0.4" water
(a)—Draft in furnace	0.16
16—State of weather	Fair and cold (10° above zero)
17—Percentage of moisture in steam	1.5%
18—Factor of correction for quality of steam	98.5%
19—Total coal as fired	67,900 lbs.
19a—Total siftings weighed back and credited to furnace	6,130 lbs.
19b—Total net coal as fired	61.770 lbs.
20—Percentage of moisture in coal as fired	3.51%
21—Total weight of dry coal fired	59.600 lbs.
22—Total ash, clinkers and refuse (dry)	5,372 lbs.
23—Total combustible burned	54.228 lbs.
24—Percentage of ash and refuse in dry coal	9%
25—Total weight of water fed to boiler	563,720 lbs.
26—Total weight of water evaporated corrected for quality of steam	555,250 lbs.
27—Factor of evaporation	1,088
28—Total equivalent evaporation from and at 212° F. corrected for quality of steam	604,112 lbs.
Average Hourly Quantities and Rates.	
29—Dry coal per hour	5,418 lbs.
30—Dry coal per sq. ft. of grate surface per hr.	11.93 lbs.
31—Water evaporated per hr. corrected for quality of steam	50.477 lbs.
32—Equivalent evaporation per hr. from and at 212° F. corrected for quality	54,919 lbs.
33—Equivalent evaporation per hr. from and at 212° F. per sq .ft. of heating surface	2.58 lbs.
Capacity.	
34—Boiler horse-power developed (average)	1,592
35—Rated capacity per hr. (10 sq. ft. H.S. per boiler H.P.)	2.126
36—Percentage of rated horse-power developed	74.9%
Economy.	
37—Water fed per pound of coal as fired	9.12
38—Water evaporated per lb. of dry coal	9.31
39—Equivalent evaporation from and at 212° per lb. of coal as fired	9.78
40—Equivalent evaporation from and at 212° per lb. of dry coal	10.14
41—Equivalent evaporation from and at 212° per lb. of combustible	11.14
Efficiency.	
42—Calorific value of 1 lb. of dry coal by calorimeter	14.800 B.T.U.
43—Calorific value of 1 lb. of combustible by calorimeter	15.800 B.T.U.
44—Efficiency of boiler furnace and grate	66.5%
45—Efficiency based on combustible	68.3%
46—Cost of coal per ton of 2,000 lbs. delivered in boiler room	$3.525
47—Cost of coal required for the evaporation of 1,000 lbs. of water under observed conditions	19.3c
48—Cost of coal required for evaporating 1.000 lbs. of water from and at 212° F.	18.02c
49—Note on smoke: Very little smoke noticeable during test.	
51—Analysis of chimney gases—	Average.
Co_2	9.7
O	10.1
C O	0.1
N by difference	80.1
52—Proximate analysis of coal—	Per cent.
(a) Moisture	0.465
(b) Volatile matter	21.467
(c) Fixed carbon	71.358
(d) Ash	6,710
(e) Sulphur separately determined 2.	

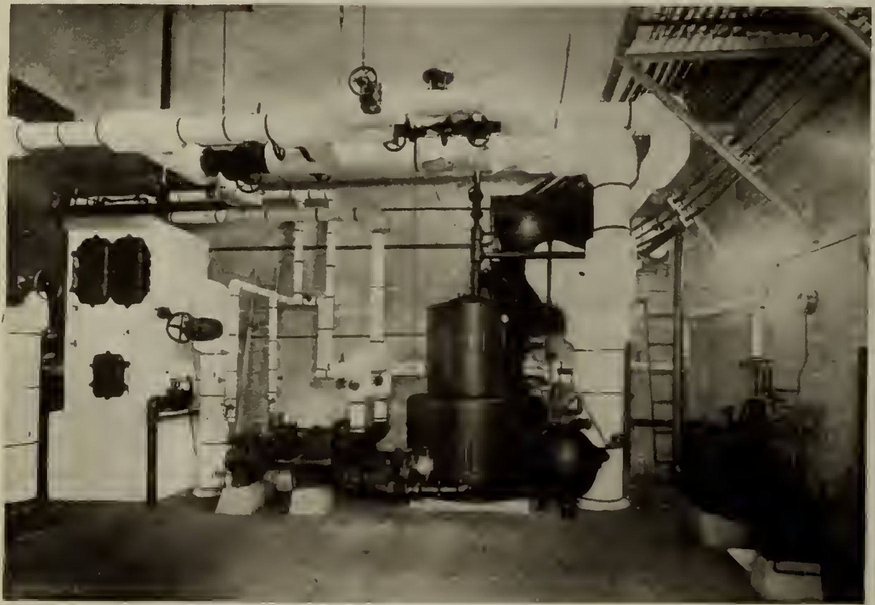

FIG. 13—AUXILIARY EQUIPMENT IN ENGINE ROOM.

As will be observed from these results, the plant possesses ample capacity for all heating requirements and, being connected to local supply sources, occasional demands for lighting current in excess of the plant capacity in operation can be instantly met without having to force the boilers or start up additional generators. These conditions enable the plant to be run at a fairly steady load with no sudden or unexpected variations so that conditions of at least as great or perhaps greater efficiency than those indicated by the test results are doubtless constantly maintained under regular operation.

Operating Data

The cost of production for three successive seasons from 1912-13 are tabulated below, as well as tables showing the amount of coal used and the temperatures obtaining during the different months of these seasons:—

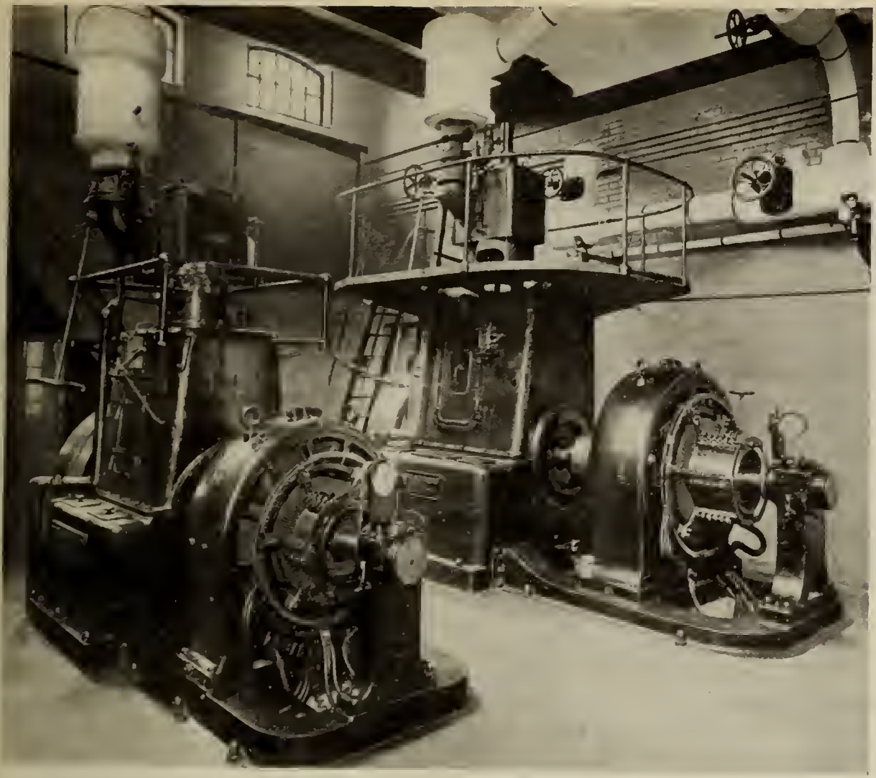

FIG. 12.—ROBB-ARMSTRONG ENGINES AND WESTINGHOUSE GENERATORS.

COST OF PRODUCTION.

	1912-13		1913-14		1914-15	
	Total cost	Cost per sq. ft. radiation in cents	Total cost	Cost per sq. ft. radiation in cents	Total cost	Cost per sq. ft. radiation in cents
Cost of coal	$29,429.52	17.22	$26,649.23	15.12	$25,135.64	12.80
Cost of city water ..	510.62	.30	265.90	.15	209.00	.11
Repairs and renewals	2,393.39	1.41	3,674.89	2.08	5,354.06	2.73
Salaries (Engineers, Firemen, Helpers).	8,713.81	5.12	7,992.47	4.54	7,972.25	4.05
Elec. cur. purchased	1.100.66	.65	1,424.24	.81	1,329.32	.66
Total cost of operat'n	$42,148.00	24.71	$40.006.73	22.70	$40,000.37	20.35
Additional Data—						
Total sq. ft. radiation		170.221		176,203		196.534
Total current generated		295,395		351,231		390,655

KILOWATT HOURS.

	1912-13	1913-14	1914-15
Total water evaporated	112,329,664 lbs.	121,657,911 lbs.	117,424,163 lbs.
Total cost of coal required for evaporating 1,000 lbs. of water under observed conditions	26.2 cents	21.9 cents	21.4 cents
Cost of evaporation per 1,000 lbs. steam	38 cents	33 cents	34 cents

Note:—1—The increased charge on repairs and renewals is accounted for by extensive alterations which have ultimately reduced the cost of operation.

2—In this distribution of cost no charge is made for light and power or High Pressure service.

TEMPERATURES

On a Basis of Average Taken from 1840 to 1898.

	1912-13. Degrees	1913-14. Degrees	1914-15. Degrees
October	50.6–4.05 above aver.	51.6–5.1 above aver.	52.75–6.20 above aver.
November	40.5–4.54 “	42.2–6.3 “	38.13–2.17 “
December	32.6–6.41 “	32.4–7.2 “	25.72–0.47 “
January	21.3–0.45 “	25.5–3.7 “	23.62–1.77 “
February	20.4–1.77 below aver.	15.5–6.7 below aver.	26.04–3.87 “
March	33.3–4.61 above aver.	30.8–2.1 above aver.	29.93–1.24 “
April	46.3–5.13 “	41.5–0.3 “	49.82–8.65 “
May	54.3–1.90 “	58.5–6.1 “	52.15–0.30 below aver.
Yearly average ...	4.29 “	3.85 “	2.89 above aver.

COAL USED.

Average daily consumption.	1912-13. tons	1913-14. tons	1914-15. tons
Sept. 25-Oct. 31	17.0	14.2	13.2
November	36.5	31.4	29.1
December	49.0	35.7	41.5
January	43.8	46.0	44.5
February	58.2	57.4	44.9
March	42.8	37.6	38.6
April	23.6	24.2	18.6
May	10.1	10.1	7.0
Total consumption	8.584	7.760	7.146

TESTING STEAM ENGINES AND BOILERS

THE value of plant tests as a means of obtaining data for the guidance of designers cannot be too highly rated. Not only to the designer, but to the operator, are the results of value, and the general lines on which tests should be conducted formed the subject of a paper presented to the Institute of Marine Engineers recently by G. James Wells, on the "Determination of Steam Engine and Boiler Efficiency and Engine Testing."

The author pointed out that the object of such tests is to find the efficiency of the plant as a whole, also that of each organ, so that the possible places for improvement may be at once detected. The efficiency may be defined as the ratio of the heat utilized to the heat supplied. Fundamentally, therefore, a test becomes in the main the measurement of quantities of heat. The engineer in charge is supplied with fuel, either solid or liquid, and it is the latent heat of this fuel that has to be accounted for, and each item of waste valued, and separated into groups: avoidable and the inevitable.

Heat Estimation

The store of heat locked up in the fuel may be estimated very closely if the chemical composition be known, or it may be determined experimentally by means of a suitable calorimeter. This quantity is usually expressed as so many units per pound of fuel. In order to liberate this heat, an apparatus must be provided for the engineer, known as the furnace, and so the processes of combustion must be examined and the exact quantity of heat liberated must if possible be measured and the initial waste due to the imperfect action of the furnace and the loss incurred determined. The wastes being determined, the knowledge obtained must be used for the purposes of improving the conditions of combustion, and so reducing the total losses to a minimum. The leakage will, of course, be due to incomplete combustion, and the loss of heat carried away by the products of combustion into the uptake. With regard to test methods in the engine-room, it was suggested that the following work is advisable: Indicator diagrams from the cylinders taken simultaneously from both ends; all gauges, revolution counters, barometer, inlet and outlet temperatures of the circulating water, read at intervals, samples of the steam tested at the boiler and engine stop valves for the amount of moisture present; the weight of water from the jacket drains as well as the separator in the steam main noted. As the engine power being developed would be practically uniform, these observations noted every 30 minutes would probably suffice both in the engine and boiler-rooms.

Record Observations

All the observations should be entered in the log of the trial with the time at which they were made and afterwards plotted upon a time base chart, so that any errors may be at once detected, and if possible corrected and allowed for when deducing the actual performance of the engines. From the data so collected the several quantities of heat required for the determination of the efficiency of the plant may be found after the manner already indicated in the previous suggestions. The chief requisite for making such a test is organization; each man should have certain duties allotted to him which he is capable of doing without too great a rush. The engineer in charge should give the signal first to stand-by and the second signal a minute later to make and record his observations. Thus each man can get close to his instruments and, looking at them, may have actually read two or three of them and only needs to watch them so that at the second signal he starts writing them down and then moves off to the other points where observations have to be made.

* * *

WESTERN ASSOCIATION OF MECHANICAL AND ELECTRICAL ENGINEERS.

THE tenth annual convention of the Western Association of Mechanical and Electrical Engineers was held in the MacDonald Hotel, Edmonton, Alta., on October 25, 26 and 27. J. F. Porter, of Calgary and district manager of the International Engineering Works, Amherst, N.S., in his capacity of Grand Chief, presided at the various sessions. The membership of this Western Association is open to engineers of all grades and classes—mechanical, civil, and electrical, further, its objects are primarily those of education and through it the development of a higner standard of operative and professional ability. Local lodges representative of the work and objects of the Association as a whole are to be found in the more prominent industrial centres of the Canadian West.

This year, during the different convention sessions, a number of topical and important subjects were disposed of, including the working of the Alberta Boiler Act, and in regard to this it was decided to take certain action with reference to its operation. Some fifteen delegates from various centres were in attendance, including the grand chief, J. F. Porter, of Calgary; E. H. Oliver, Lethbridge; W. N. Simpson, of Nordegg, organizing secretary; W. G. Singer, of Edmonton, general secretary, and others.

The election of officers resulted in J. F. Porter being grand chief for another year; E. H. Oliver, of Lethbridge, was chosen as vice-chief, and W. G. Singer, as secretary-treasurer.

On Thursday afternoon, Oct. 26, the delegates, their wives and friends were taken for an automobile run out to Fort Saskatchewan where they were shown around the Provincial Jail by the chief engineer. During the same evening a well attended meeting was held at which W. G. Singer, Grand Secretary read a paper on the Inspection of Steam Boilers, and B. J. Serhey, manager of Metals Ltd., read one on Storage Batteries.

The annual banquet of the Association was held at the Cecil Hotel on Friday evening, October 27, and proved a most attractive and successful event, the company of fifty including a number of ladies, in addition to the members of the Association. The excellent menu provided by the caterers was greatly enjoyed, as also the short but interesting program of music intermingled with speeches. During the course of the evening a photograph of the assembled company was taken.

W. W. Simpson, a typical "Scottie," presided, and in a characteristic speech extolled the virtues of the engineer, crediting him with intelligence, sobriety and courage, citing as an illustration the example of the famous "Casey Jones." The chairman's sentiments were highly applauded. He spoke further of the objects of the association, which, he said, were to make good engineers and good electricians.

The grand chief, J. F. Porter, in a short and pithy address, made an appeal for a wider membership, and also spoke of the development of engineering during the last century.

An interesting address was also given by the Rev. F. S. McColl, principal of Alberta College North, who took things to a higher plane and spoke of the influence of good societies and men in ridding the country of evil tendencies and making for purity and righteousness in its administration.

BANQUET GROUP, TENTH ANNUAL CONVENTION WESTERN ASSOCIATION OF MECHANICAL AND ELECTRICAL ENGINEERS. EDMONTON, ALTA., OCT. 27. 1916.

Electricity and Hydraulics

ELECTRICITY AND THE ECONOMICAL USE OF COAL*

By R. A. Chattock, M.I.E.E.

IN a report of the Royal Commission on Coal Supplies in 1905, an average figure of 5 lb. of coal per horse-power hour was given as being the consumption obtained by industrial concerns in connection with the production of their own power. In the most modern electric power stations this figure could be reduced by about one-half. An economy of 50 per cent. in the coal used for driving our factories should fully justify strong measures being taken to make it obligatory upon manufacturers not to waste coal in the way that has been going on to a large extent up to the present.

A Committee of the British Association has been appointed to look into and report upon this particular question, both with a view to economising the use of fuel and for the prevention of smoke. The deliberations of this Committee, so far as they have gone, lead one to believe that the greatest economy in the use of coal can be obtained by gasifying it and recovering its valuable by-products. This must be done on an enormous scale to be really effective. It is impossible for individual manufacturers to do this with anything like the economy that could be obtained if the whole of the coal used in the country were so treated at certain convenient centres. The number of processes involved is very considerable, and the handling of each by-product would practically be a business in itself. The capital cost involved would be heavy, and could only be made remunerative by working the process on a very large scale. I think, however, that if only for the proper conservation of the available coal supplies such a scheme should be developed.

Coal Energy Transformation

The transformation of the energy in the coal into electrical energy is the one link that renders a scheme of this kind possible, because if all the coal consumed in the country is so treated at certain centres, the energy produced would be transmitted all over the country, for use wherever it was required. The only way of doing this with a reasonable capital expenditure is electricity. The plants would have to be installed as near to the great coal centres as possible, having due regard to a sufficient supply of water being available for condensing purposes. This is a very important consideration, and may necessitate placing them within reach of the sea or on tidal rivers.

Electrical Energy Application

It must not be forgotten that electrical energy can now be efficiently applied to practically all purposes for which coal is now being used. Such purposes are:—Power for driving factories; power for driving railways, steam and electric; heating of furnaces; all domestic uses, such as heating, cooking, and lighting; public utility services, such as lighting, pumping, etc.

If, therefore, energy can be produced and transmitted in this way at a figure that compares favourably with what it at present costs the consumer to supply himself, the justification for such a scheme is fully made out.

Experience in the past has shown that large modern generating stations, employing the most economical apparatus obtainable, have been able to supply electrical energy at a figure considerably below what obtained ten years ago, and one that is still being reduced from year to year as the stations continue to grow, and as the load factor of the stations is increased. The largest stations have approximately something like 100,000 kilowatts of plant installed in each. If stations were to be built to supply electrical energy for practically all purposes for which coal is now being used, they would require to be probably five times this size, or, say, 500,000 kilowatts capacity of plant installed. In stations of this size it would be quite possible to arrange for some of the boilers to be fired by means of gas, and for others to be fired by coke or other form of fuel that is produced from the distillation of the coal. At the same time, the valuable by-products in the coal could be recovered and disposed of, thus reducing the cost of the supply of electrical energy to the consumers.

A scheme of this kind would lend itself admirably to the utilisation of the poorer quality coals, which in normal times it hardly pays to work. In the report of the Royal Commission on Coal Supplies referred to above, it was estimated that this unworkable coal amounted to about 25 per cent. of the total coal raised from the pits. If such an enormous quantity can be beneficially utilised for the production of electrical energy, instead of being wasted as at present, that alone should go far to justify the adoption of a scheme such as I have outlined.

Gasification of Coal

Coal can be gasified in two ways—either by high-temperature distillation or by low-temperature distillation. High-temperature distillation is used for the production of ordinary town gas, and certain by-products are obtained, such as coke, coal tar, etc. A number of products are, however, destroyed in this process. Low-temperature distillation produces a form of smokeless fuel, different to coke, in that it will burn in an open fire-grate. In addition to this, a number of other valuable by-products are produced. In order, however, to obtain the same amount of heat energy in the form of gas by this process, a very much larger quantity of coal has to be treated. Something like six to eight times the weight of coal has to be handled to produce a fixed quantity of electrical energy as would have to be handled if the coal were burned to destruction in the boiler fires.

In all probability, further research work on the subject of distillation of coal will produce even better results than are now obtained. So far these results point to the necessity for converting the heat units in the gas and in the coke or other fuel produced as well into electrical energy, otherwise there would probably be difficulty in disposing of all the fuel on the outside market. It will be seen, therefore, that a scheme of this kind will occupy an enormously greater area of ground than the ordinary electric generating station does at present. The production of electrical energy from a scheme, such as outlined, at a cost far below what obtains at the present time, would make it possible for all users of coal to economically use electrical energy in substitution thereof. Owing, however, to the conservative nature of the average man, it is very doubtful whether such a change could be brought about quickly enough to justify the erection of these large super-stations, and to make them pay for themselves within a reasonable time, without some special steps being taken for the purpose.

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*From Presidential address, Birmingham Association of Mechanical Engineers.

Electrical Supply Development Proposition

The very slow development of the electric supply business in the past, does not hold out much hope of any real progress being made by natural development, and in order that the public may obtain quickly the benefits that will be afforded by such a scheme, it would appear that some form of compulsion should be exercised in bringing it about. Such a course would, in my opinion, be fully justified, having regard to the national importance of the results that would be obtained:—

(1)—By the proper conservation of the coal supply of the country.

(2)—By the elimination of smoke from our atmosphere.

(3)—By the possibility of giving a supply of power to manufacturers and other users at a figure so low that it would represent a saving in their cost of production, and consequently a most valuable asset to the commercial prosperity of the country, and a weapon to fight foreign competition.

(4)—By relieving the congestion on the railways owing to the reduced traffic of coal, which at present has to be delivered all over the country, and under this scheme would only have to be delivered by special lines to certain fixed centres.

Compulsion could be exercised directly by Government control of the coal supply of the country, or indirectly by putting a tax upon all users of coal who consume it in an uneconomical manner. Such a tax should be utilised for financing a scheme of the kind indicated until it became self-supporting.

In pressing for the adoption of this method, by which such an enormous economy could be effected, there is bound to be very serious opposition from many existing interests. It is obviously impossible to inaugurate such a change without interfering to perhaps a large extent with those interests, but if the great benefits to be derived from it are proved by searching inquiry to be obtainable, then, in the writer's opinion, the Government ought to take the matter up and deal with it from a national necessity standpoint.

DRY DOCK PUMPING PLANT AT PANAMA

THERE has recently been carried out a series of tests with the pumping plant at Dry Dock No. 1, Balboa, says The Canal Record. The plant comprises four 54in. main pumps and two 20 in. drainage pumps, each with a vertical induction motor, all housed together with the necessary accessories and the motor-driven air compressors in the building on the south wall of the dry dock at its entrance. The conditions entered into with the H. R. Worthington Co., contractors for the entire plant, required that each main 54 in. pump should discharge an average of 11,100 cubic feet per minute of sea water when pumping against a rising tide. which tide is specified to reach an elevation + 8.5 when the dry dock floor, at elevation —39.5, is bare of water.

The average overall efficiency of the units was guaranteed to be 64.5 per cent. including all losses in motors and pumps. The 20 in. drainage pumps were required to have an average capacity of 1,375 cubic feet each, with an overall efficiency of 64 per cent., when pumping from the culvert below the floor of the dry dock, from elevation—42 to elevation—52 with the tide rising from elevation 0.0 to elevation + 8.5. It was found that with 35 feet of water in the dock, one main pump can lay bare the floor in 5 hours 10 minutes.

On July 18, at 4.20 a.m., all four main pumps were run at once, starting with about 47 feet of water in the dock. On this run the dock was emptied in 1 hour 45 minutes. The drainage pumps emptied the culvert under test conditions in about 2 hours 40 minutes, showing them to be above the special capacity. While the complete computations have not yet been finished, sufficient calculations have been made to show that each unit exceeded the guaranteed capacity and efficiency. The pumping plant, with the air compressors controlled from the same switchboard, constitutes the largest single electric load on the Isthmus. If all pumps and compressors are running, a total of about 7,500 h.p. is required, or almost the entire present output of the hydro-electric installation.

INDUSTRIAL LIGHTING

AS to whether the supply of current in the case of a large industrial establishment should be taken from a private plant on the consumer's premises, or from the public supply, is a question which has often been raised, but never definitely settled. It has again been discussed before a meeting of the Junior Institution of Engineers. The central station man is, or should be, a salesman, and is entitled to use all legitimate means of pushing business. Such items as the first cost of a generating plant, interest and depreciation thereon, and the need of skilled labor to look after it, can readily be used as a means of suggesting to the lay mind that to take the supply off the public supply mains is the only economical thing to do.

This does not necessarily follow, however, and essentially so in the case of establishments where a power plant is put down. The additional cost of making provision in the power plant for supplying the lighting current is commonly such as to render it well worth doing on economical grounds, whether the plant be for the distribution of the power mechanically or electrically. With a supply from his own plant the owner has not to watch possible variations in the annual cost of current due to such causes as minimum or maximum demand, total units consumed, etc., nor to enter into any agreement for a number of years in order to get down to what may appear to be a favorable rate for supply.

Question for Individual Consideration

The whole question must be thought out in an unbiased way, due regard being paid to all the conditions affecting the particular case under consideration. In settling upon a supply from the public service, the factory owner is frequently well in need of independent advice as to agreements for charging, if the most economical arrangement is to be arrived at. When a typical agreement is put forward for consideration before the prospective consumer can be advised as to taking up same, it is necessary to weigh very carefully the several conditions which are commonly sought to be imposed. Such, for instance, are requirements that all the consumer's lighting must be taken from the one source of public supply only, and this for a period of, say, three, five or more years.

Further than this, the rate of supply and system of charging are both fixed for the whole period, regardless of possibilities which might prove advantageous if they were open to be adopted. Supply authorities frequently offer alternative methods of charging, usually a flat rate; a maximum demand system is also one of its several forms. With a combined power and lighting load, it is not unusual for a consumer to be allowed to have a certain proportion of the total units consumed, of perhaps 10 per cent. to 15 per cent., to be allocated to lighting, any proportion above this being charged at a somewhat higher rate. In factories where the load is mainly power, this works out very satisfactorily for the consumer, and likewise, no doubt, to the supply authority.

BEARINGS FOR ELECTRICAL MACHINERY—I*

By Andrew Gibson.

THE electrical engineer has not only to keep bearings in good running order, but on occasions has to decide which type of bearings is most suitable for certain conditions of load. At first sight it would appear that problems regarding bearings are easy of solution, but this is not so, as is proved by mysterious cases of heating and seizing of a perfectly sound bearing, which is perhaps one of three identically the same on the same shaft. Bearings give most anxiety when running a plant for the first time, and those in charge watch carefully for possible distress indicated by the bearings becoming hot.

Cause of Heating

Heat in a bearing is the result of friction, and friction is defined as:—"That force acting between two bodies of their surface of contact, when they are pressed together, which tends to prevent their sliding one upon the other." The energy used in overcoming this force of friction appears at the rubbing surfaces as heat, and is ordinarily dissipated by conduction through the two bodies. It is a matter of common experience that the resistance to sliding can be greatly lessened by the introduction of an oily or greasy film between the rubbing surfaces. Beauchamp Tower, in his famous experiments, found that a steel shaft in a gunmetal bearing lubricated with sperm oil seized at a pressure of about 600 lb. per square inch, under steady running, whereas when dry the same materials seized at about 10 lb. per square inch.

The oily or greasy film between the shaft and bearing seems to act in the same way that a great number of metallic balls would, by supporting the load and keeping the surfaces apart. If by any chance this film is broken down the surfaces come together, resulting in metallic friction, and overheating takes place; the two surfaces then appear to weld themselves together, and if the bearing be forced round small pieces are torn out of both surfaces, and the bearing is said to "seize." The load at which this occurs depends chiefly upon the viscosity of the oil; temperature is also a determining factor, as the viscosity of the oil varies with the temperature, oils becoming thinner with increase of temperature. The thicker and less free-flowing an oil is, the greater unit pressure it will stand in a bearing without squeezing out. A watch oil or very light spindle oil would stand, say, a pressure about 50 lb. per sq. in., whereas a cylinder oil of good body will stand a pressure of over 2,000 lb. to the sq. in. on the same bearing. Therefore, the unit pressure which any bearing will stand depends chiefly upon the lubricating film, which, in turn, is influenced by the arrangement of the bearing surfaces.

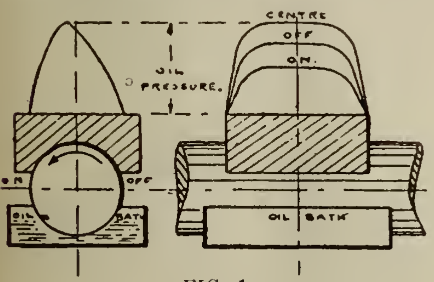

FIG. 1.

Surface Requirements

These surfaces must be such that they help to preserve the lubricating film; the wearing surfaces must be perfectly smooth and of sufficient area and uniform bearing surface, the bearing a trifle larger in diameter than the journal. The allowance commonly made for the running fit of the bearing and shaft is about 0.0005 (D+1) where D is the nominal diameter of the shaft in inches. Some manufacturers of fast-running machinery make the diameter of the bearing exceed that of the shaft by nearly twice that amount. This clearance allows the shaft to take up an eccentric position in the bearing, leaving a space on the side from which the load is applied. It is at this point that the lubricant should be introduced, so as to spread itself upon the shaft, adhere to it, and travel round upon the surface, and be forced between the bearing surfaces at the pressure necessary to support the load.

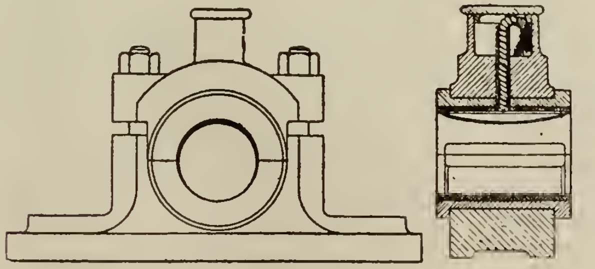

FIG. 2.

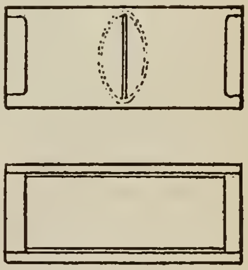

FIG. 3.

It does not seem possible that the velocity of the oil and its adhesion to the shaft can produce a pressure per sq. in. corresponding with a heavy load, by what may be called an adhesion pump. By means of drilling holes and fitting pressure gauges, Tower found that a journal was completely oil-borne and gave a pressure diagram like that shown in Fig. 1. The pressure is greatest on the off side.

Distribution of Lubricant

In order to distribute the lubricant uniformly over the surface of the journal, and also to collect the oil, it is necessary to cut oil grooves in the bearing. This is a matter requiring great care and attention as a groove placed where the oil is under pressure would act merely as a collector for the oil and provide it with a path of escape before it had accomplished its purpose. Consider the case of an ordinary type of plummer block as shown in Fig. 2.

The oil is supplied drop by drop through a hole in the cap. If there were no oil grooves only a narrow band of the shaft revolving immediately under this hole would be reached by the oil. If now, we cut a shallow groove in the cap, lengthwise in the bearing, and reaching almost but not quite to the edges, the oil will be enabled to spread itself right across the shaft. To this groove may be added two, as shown by dotted lines in Fig. 3, which shows the under surface of the cap unrolled, and lying flat. No series of grooves can be cut in the box which will distribute the oil as well as or as thoroughly as those shown. Having distributed the oil over the surface, the next care is to see that it is not wiped off before it reaches the part for which it is intended. Accordingly, artificial inclined planes are cut where the two halves meet, and a portion of the surface at each end is left, which serves to retain the reserve of lubricant. The inclined planes must be very carefully cut, and must die away at a point exactly equidistant from each end of the bearing. In the bottom half of the bearing shallow grooves, parallel to the ends of the bearing, may be cut; these grooves will catch any oil that may be squeezed out at the ends, and divert it where it can be used again.

If the load had been applied upwards instead of down, as shown in Fig. 2, it would have become necessary to introduce the lubricant at the bottom instead of the top. This case is similar to a railway axle, and the method generally adopted in this class of work is to wet the shaft by means of an oily pad held on the bottom side of the journal.

It is futile to have a hole on the resultant line of pressure, for not only cannot oil be possibly fed to the bearing by such means, but the oil is forced out through the hole under pressure at exactly the spot where it is most required. If oil holes are used they must communicate with a part of the bearing where there is little or no pressure.

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*Read before West of Scotland Branch of Association of Mining Electrical Engineers.

Design of Grooves

As much thought and care should be given to the grooves as to the rest of the bearing; and it should be kept in mind that their function is to distribute the oil between the bearing and shaft where the load is not supported. Beyond such place the surface of the bearing should gradually incline towards the shaft, and further, there should be no holes, channels or other means of escape for the lubricant from between the surfaces where the load is supported.

If the surfaces of the shaft and bearing are perfect, and the lubrication sufficient, there is no metallic friction, but only fluid friction between the shaft and the bearing. But during the time of starting or stopping the film is broken, resulting in metallic friction. The shaft is generally steel, which is chosen for its strength, but in the choice of a proper bearing material there is a whole host of materials from which to choose, the chief being cast iron, steel, gunmetal, phosphor-bronze, and white-metal alloys. When selecting a bearing material the following requirements hsould be kept in view:—It must have sufficient strength to sustain the load put upon it; it must not heat rapidly; it must be easily worked; it must have good anti-frictional properties; it must have a long life, with small loss of material due to wear. With the exception of cast iron on cast iron and hardened steel on hardened steel, it will be a material of entirely different molecular construction, having preferably less strength than that of the revolving journals which it supports, as it is most important that the bearing should suffer rather than the shaft, in case the oil supply fails. If the lubrication fails from any cause, and the surface of the shaft comes into contact with the surface of an iron or bronze bearing, both are cut and scored, but if the bearing is composed of a soft metal the risk of injury to the shaft is not great.

Anti-Friction Metals

Such materials are usually white-metal alloys, including alloys of tin, antimony, lead and zinc, with copper and other metal to harden them. Any alloy that will stand a compressive pressure of over 4 tons per sq. in. may be considered safe for general purposes; but for connecting-rod bearings, the metal should be able to stand a pressure of 6 tons per sq. in.

The proportions of the different metals in the alloys vary considerably, according to the weight carried and the speed of the shaft. A mixture for heavy work that has been found to work well in practice is:—Tin, 83.5 per cent.; copper, 3.25 per cent.; antimony, 13.25 per cent. One for light service is:—Tin, 89.5 per cent.; copper, 1.75 per cent.; antimony, 8.75 per cent. The antimony gives the hardness and diminishes the contraction, whilst the tin gives it the anti-friction property. A metal used for bearings that do not carry very heavy loads and are not subjected to shocks consist of 80 per cent. lead and 20 per cent. antimony. For bearings of gas-engine shafts, etc., where the momentary loads are high, an alloy containing tin 90 per cent., copper 2 per cent., and antimony 8 per cent. is suitable; this is much more expensive than the ordinary white-metal.

Lead in a white-metal allows of it being cast with less care, and causes it to adhere to the tinned surface of the shell. This is due to the property it possesses of reducing the contraction of the alloy on solidification. The strongest argument in favor of lead is its smaller cost. However, a lead-base metal is not so foolproof as the tin-base, the range of pouring temperature being more limited.

Seizing

Seizing is very rare indeed with soft metal bearings; this is probably due to the metal flowing and adjusting itself, when any uneven pressure comes upon it due to minute irregularities in the journal. White-metal alloys have other advantages; they can be easily worked and can be melted in an ordinary iron ladle, so that no special equipment is required for the replacement of worn bearings.

DEATH OF CAPT. F. R. NEWMAN

THE death of Captain Frank Ross Newman in London, England, on October 23, as a result of wounds received in action, will be received with regret by a wide circle of friends. Capt. Newman was wounded on Sept. 28th on the Somme front and was progressing favorably, until tetanus supervened, resulting in his death. He had previously been invalided to England suffering from trench fever, but recovered, and was able to return to duty. Capt. Newman was born in Montreal in 1879, and was educated in that city, graduating from McGill University.

THE LATE CAPTAIN FRANK ROSS NEWMAN.

He started his business career with Caverhill, Learmont & Co., wholesale hardware, Montreal, his father, Thomas H. Newman, now deceased, being a partner in the concern. In course of time he left this firm, and went to Winnipeg to open a branch office for the Canadian Fairbanks Co., being appointed manager. He eventually resigned this position and joined the staff of the Laurentide Paper Co., at Grand Mere, Que. In 1911 he returned to the Canadian Fairbanks-Morse Co. as manager of the Toronto sales office, which position he held until the autumn of 1914, when he resigned upon being appointed to a captaincy in the 19th Battalion, C.E.F.

Soon after coming to Toronto in 1911, Capt. Newman joined the Queen's Own Rifles as a lieutenant, and was an officer in that regiment until his appointment as captain and quartermaster of the 19th Battalion, which went overseas in the spring of 1915.

The deceased was unmarried, and is survived by his mother, who lives in Montreal, and also by two brothers, Capt. Harry Newman, of the 5th Royal Highlanders, and John Newman, manager of the Montreal branch of the McClary Mfg. Co. His only sister married Capt. Gurd, Canadian A.M.C., who is now on active service. His mother sailed for England just before the arrival of the cablegram announcing her son's death.

Capt. Newman was as keen and efficient as an officer as he was in business. His kind and genial disposition endeared him to all with whom he came in contact. He was a man of peace, but died loyally serving his country

LOW PRESSURE STARTING OF DIESEL ENGINES

EXPERIMENTS by Professor Watkinson of Liverpool, in the starting of Diesel engines have yielded interesting results. According to the investigator it is not upon the height of compression but upon the ratio of compression that the temperature of a compressed gas depends, and the desired ignition will therefore take place spontaneously with a much lower compression pressure than has hitherto been considered essential. So far, however, this method has only been used for starting the engine, and further developments are awaited with interest as to whether combustion is sufficiently complete to render possible continuous running at low compression pressures.

Power Transmission Section

PRESSURE OIL FILM LUBRICATION*

By H. T. Newbigin, A.M.I.C.E.

THE primitive form of journal bearing is merely a hole bored in the frame of a machine in which a shaft revolves, and the primitive thrust bearing is only a collar or shoulder on a shaft to prevent it moving endways. These fulfil their function satisfactorily for many purposes, but as the rubbing speed increases, either due to an increase in the shaft diameter or an increase in the speed of its rotation, or both, it becomes necessary to devote more attention to the design of these machine parts, apart altogether from the effect of a reduction in friction on the efficiency of the machine as a whole.

Without lubrication a bearing will not run without excessive wear, and without artificial cooling no bearing with oil lubrication will run continuously if the temperature rises above 150 deg. F., because at about this temperature most oils begin to carbonize. The efficiency of a bearing must, therefore, be such that the temperature due to the heat generated by its friction, minus that dissipated by radiation and conduction, does not exceed this figure. In order to reduce the friction between two rubbing surfaces it is necessary to put something between them, and bearings may be classified into those in which this is a hard material such as steel balls or rollers, or a viscous substance like oil or grease.

Ball and Roller Bearings

The first class does not consist merely in introducing balls or rollers between the relatively moving surfaces in the primitive forms of journal and thrust bearings, they are highly specialized machine parts designed to utilize to the greatest advantage the rolling action of balls or rollers in reducing friction, and their design is evolved from a study of this action. On the other hand (except in the cases to which reference will be made later), the second class consists merely in applying a lubricant to the primitive forms, or to some slight modification thereof. They are not designed to utilize the action of the lubricant on any principle, the lubricant is merely added to the primitive forms because it has been found to make them work better. Ball and roller bearings have attained to a remarkable degree of perfection, and they are admirably suited for bearings in which the loads to be carried are comparatively light, or in which the motion is intermittent, but they are not suited to carry heavy continuous loads, especially at high speeds.

In ball bearings the steel balls make point contact with hardened steel races, and the balls tend to flatten at the point of contact. Under excessive continuous loads this slight deformation of the balls causes their outer surface to shell off, the chips get under the other balls, and ultimately destroy the construction of the bearing. The life of the balls is limited, frequent renewals are necessary, and to effect these renewals it is essential to dismantle the bearing.

In roller bearings the rollers make (or are supposed to make) line contact with the housing and with the shaft. Although they are able to carry heavy loads, it is very difficult to maintain correct alignment, and any slewing of the rollers sets up a heavy end thrust against the cage in which they work. Furthermore, as the rollers bear directly on the shaft, the constant rolling action tends to laminate the surface and so wear it away. In roller thrust bearings it is necessary to make the rollers conical, and as they therefore have a heavy radial thrust this type of bearing is not much used.

The great advantage of both ball and roller bearings is their low starting friction; for this reason they are especially suitable for intermittently moving machinery, but in continuously running machinery, where a low starting friction is of less importance than a low running one, it is obviously a great advantage to have the rubbing surfaces separated by something more easily replaceable than either balls or rollers, especially if it is something that can be continuously replaced without stopping the machine, and the more so if it is also capable of being used in high-speed bearings as a medium for carrying away the heat generated by friction from the actual surface of its origin.

It is with the second class of bearings—those in which the surfaces are separated by a fluid such as oil in the case of high-speed and grease in the case of slow-speed bearings—that this paper is more immediately concerned. The use of a lubricant for the purpose of reducing friction is very old, but the study of its action, and more especially the manufacture of bearings designed to utilize this action to the best advantage, is quite modern.

Lubricant Action

The action of a lubricant is twofold: it first of all alters the nature of the rubbing surfaces, thereby reducing friction (and this is the commonly accepted justification for its use), but under favorable conditions it goes much further than this and automatically generates a high-pressure oil film between the surfaces, entirely eliminating metallic contact and thereby enormously reducing the friction. This is what is now called "pressure oil film lubrication." It occurs to a limited extent in most journal bearings, but does not occur in ordinary collar-thrust bearings.

The phenomenon of pressure oil film lubrication was first noticed by the late Beauchamp Tower during the course of a series of tests he made in conjunction with the Institute of Mechanical Engineers in 1883 and 1885. He found, while experimenting with a journal bearing, that under certain conditions the rotation of the shaft was capable of dragging the oil adhering to it in between the surfaces to such an extent as to force the surfaces apart with a high-pressure oil film, and that the highest pressure in this oil film was about twice the average pressure. He also found that the highest pressure was on the longitudinal centre line of the brass and a little forward of the sectional centre line in the direction of rotation, and that from this point the pressure fell to zero around the edges of the brass. A bearing under these conditions runs with very much less friction than under any other, and will carry a much higher load.

Following on Tower's experiments, the late Professor Osborne Reynolds, F.R.S., in a paper read before the Royal Society in 1886 on "The Theory of Lubrication," showed that the friction under the circumstances was merely that due to the viscous flow of the oil, and he showed how, by calculation based on the theory of viscous flow, a pressure curve may be obtained which closely approximates to that obtained experimentally by Tower.

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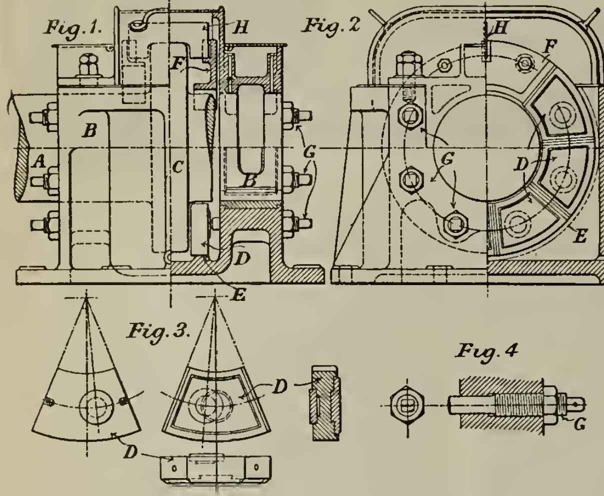
*Part I. of a paper read recently before the British Association.



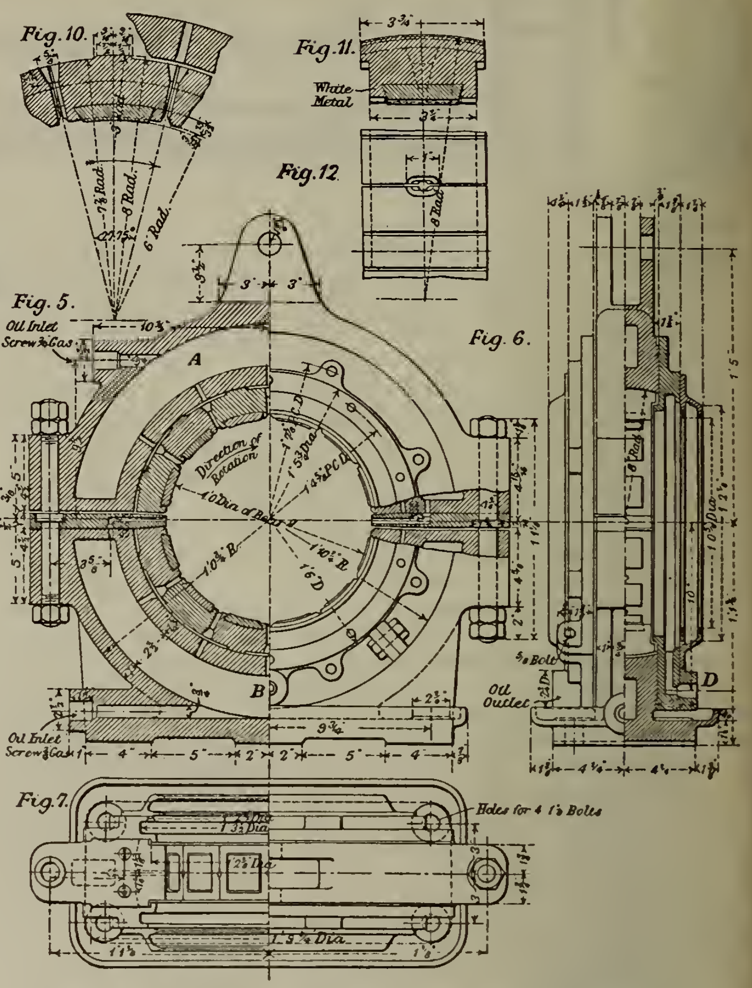
MICHELL THRUST BEARING DETAIL.

In his theory Reynolds made the assumption that the length of the bearing, i.e., the dimension at right angles to the direction of motion, was infinite, and as this is never the case in practice, his theory was of little practical value and it did not lead to any alteration in the construction of bearings. From the practical point of view the most important things that he showed were:—

Firstly—That in order to obtain a pressure oil film between lubricated surfaces the surfaces must have a slight inclination to each other, with the opening at which the oil enters greater than that at which it leaves. Or, in other words, that the oil film must be wedge-shaped.

Secondly—That in the case of a journal bearing the wedge form of the oil film occurs naturally, due to a slight shifting of the centre of the shaft in relation to the centre of the brass.

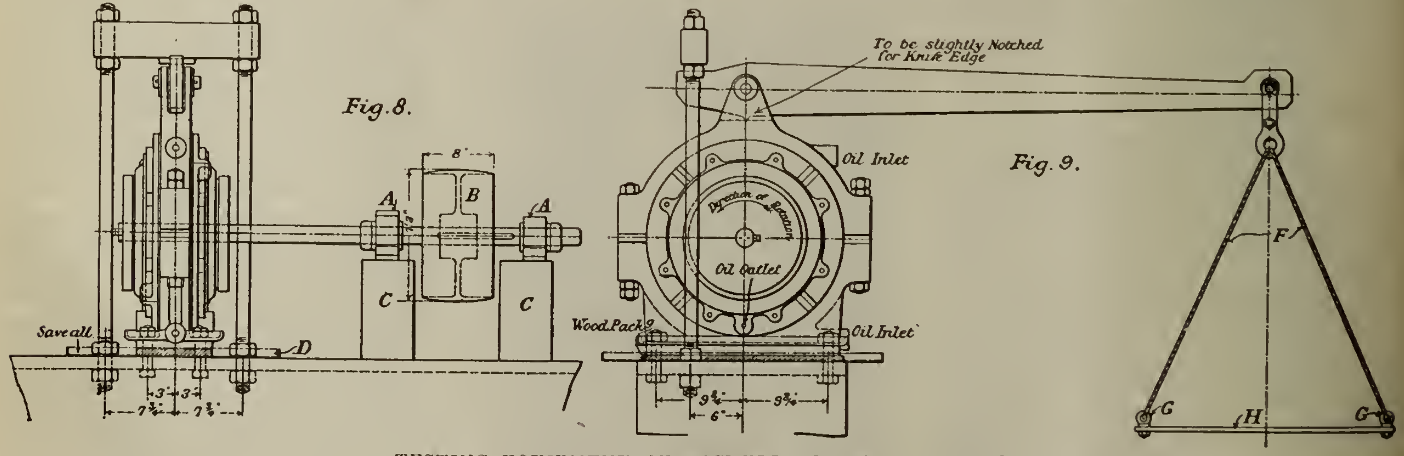
Thirdly—That such a wedge-shaped oil film cannot occur in a collar-thrust bearing; hence their inefficiency and low carrying capacity.



DETAIL OF MICHELL JOURNAL BEARING AS TESTED.

It was left to an Australian engineer and mathematician, A. G. M. Michell, of Melbourne, not only to complete Reynolds's theory, but also to show how its teaching can be applied in practice, to the vast improvement of both thrust and journal bearings.

In a paper published in "Zeitschrift für Mathematik und Physik" (unfortunately a German publication) in 1905, on "The Lubrication of Plane Surfaces," he gave the complete mathematical solution of Reynolds's theory as applied to plane rectangular surfaces. On the assumption that the thickness of the oil film at the entering edge is twice as great as at the leaving edge, he showed how lines of equal pressure within the film can be plotted and how the centre of resultant pressure can be determined for plane rectangular surfaces of varying proportional cross dimen-



TESTING EQUIPMENT OF MICHELL JOURNAL BEARING.

sions. He also demonstrated practically that a rectangular block pivoted at its point of resultant pressure will automatically assume an angle to an opposing lubricated surface, depending on the speed of rubbing, viscosity of the oil and pressure. On this principle he founded his now well-known thrust bearing.

The result of Mr. Michell's work has been to enable lubricated thrust and journal bearings to be designed with the principles of oil film lubrication as a basis, in the same way as ball and roller bearings are designed with the ball or roller as a unit, and as distinguished from the mere application of oil to the primitive forms of these bearings. The essential feature of the Michell bearings is the sub-division of the stationary surface into a number of blocks or pads, each pivoted at its back, and so free to assume a slight angle with its contacting surface. Bearings designed on this principle differ radically from the primitive forms of journal and thrust bearings, but the results obtained in practice have fully justified the change.

Thrust Bearing Comparisons

Taking the case of the thrust bearing first, the Michell thrust bearing differs from the older type in having only one collar, the multiplicity of collars in the older type having been necessitated by the low carrying capacity of parallel rubbing surfaces, as distinguished from the high carrying capacity of those in which the fixed surface is sub-divided and made free to assume the angle to the opposing collar necessary for the formation of oil pressure within the film.

The importance of efficiency in machinery is not merely a question of economy of power or fuel, it also controls the practicability of a design, and the design of bearings is an example of this For example, in the design of a large multicollar thrust bearing (which is merely an elaboration of the primitive form) the problem the designer has to solve is governed by the efficiency of this form. He has given a shaft of a certain diameter, revolving at a certain speed, and which has to withstand a certain thrust. The resistance to turning will be about 0.03 of that thrust, and the greatest load that the bearing surfaces will carry with safety is about 50 lb. per square inch.

Low Coefficient of Friction Essential

In order to bring the pressure down to this figure, he may either use a few collars of large diameter or a number of collars of small diameter. If he does the former, he increases the radius at which the friction acts, and so the power absorbed and the heat generated, and if he does the latter it becomes increasingly difficult to maintain an equal distribution of the load among the collars, especially under the variations of expansion due to the heat generated when the bearing is at work. Furthermore, whatever compromise he makes, there comes a point beyond which the size, load and speed cannot be increased because, owing to the high coefficient of friction, the heat is generated more quickly than it can be dissipated by radiation and conduction, even with the aid of water cooling.

This point was reached in the case of the thrust bearings in geared turbine-driven vessels, and partly because the bearings were found to be less able to withstand thrust under the uniform turning movement given by this type of engine than under the varying turning movement given by reciprocating engines. It therefore became necessary to find a form of thrust bearing in which the coefficient of friction is lower than that in the primitive type.

Michell Thrust Bearing Details

The Michell thrust bearing, which goes to the root of the matter and is designed from the point of view of the action of the lubricant in automatically generating a pressure oil film between the surfaces, has formed a complete solution of the difficulty. It has a coefficient of friction of about 0.0015 as against 0.03, and carries 200-300 lb. per square inch with a much greater factor of safety than the primitive form has at 50 lb.

The sub-division of the fixed surfaces into a number of segmental tipping blocks or pads is the essential feature of all thrust bearings made on this principle, but there are many variations in the design of the housing and method of carrying the tipping blocks, depending on the particular use to which the bearing is to be put.

Figs. 1 and 2 show sectional side and end views of one form in which marine thrust blocks are made. The shaft A is supported in two journal bearings B, one on each side of a single collar C, which bears against two series of segmental pivoted blocks D, arranged in the form of two inverted horse-shoes, the one for "ahead" and the other for "astern" thrust. The blocks D—each of which is pivoted, somewhat behind its centre, on the ends of the screws G—rest on two ledges E, concentric with the shaft. They are prevented from rotating with the shaft by means of the stops F, by removing which they may be taken out without disturbing the adjustment of the screws G or lifting the shaft. Figs. 3 and 4 show a detail of one of the blocks D, and of its screw G.

The body of the housing forms an oil well in which the collar revolves, and a scraper H is provided to scrape off the oil brought up by the rotating collar for the purpose of lubricating the upper blocks. This type is self-contained as regards lubrication, and in the case of large sizes, or those running at a high speed, the body of the bearing is water-jacketed. The friction is about one-twenty-fifth of that in the multicollar type.

Steam Turbine Thrust Bearings

In the case of the thrust bearings in steam turbines the type adopted is somewhat different. The blocks are symmetrically disposed around the faces of the collar, and each series is mounted on a ring partly spherical on one face, the convex surfaces of which are outward and rest on correspondingly spherical seats for the purpose of automatically distributing the load among the blocks. The blocks are mounted on the faces of the rings next the two sides of the collar against which they pivot, either along radial lines or on rounded pins.

This type is entirely enclosed, and is supplied with an oil circulation by means of an independent pump. The oil passes through an oil cooler on its course, thereby removing the heat generated by friction from the actual surface of its origin. The mean rubbing speed sometimes exceeds 100 ft. per second. Slow speed bearings are made on the same principle, with grease lubrication.

Upwards of 800 Michell thrust bearings are now running in Great Britain alone, in sizes varying from 1 to 15 in. diameter of shaft, and larger sizes are in the course of construction. The use of them is rapidly becoming the standard practice in steam turbine work. The same principle is now being applied to journal bearings.

Journal Bearing Comparisons

In lubricated journal bearings of the primitive type (as already stated) the phenomenon of pressure oil film lubrication occurs naturally, due to the slight shifting of the centre of the shaft in relation to the centre of the brass, but its occurrence is much less marked in the case of bearings of large diameters, probably owing to the greater oil clearance that is necessary in large sizes and to the extreme thinness of the oil film. For example, a journal bearing of 2 or 3 in. in diameter will run satisfactorily under a pressure of 300 to 400 lb. pressure per square inch, but it is not found advisable to load large bearings above 100 lb. even with a forced oil circulation.

The pressure oil film only occurs along a narrow strip in the primitive type, and the remaining surface merely forms a brake on the rotation of the shaft. So that the designer is again restricted and can only reduce the pressure to the limit found safe in practice by increasing the length of the bearing. By sub-dividing the circumferential surface into a number of segments, each of which is pivoted at its back and thereby free to form an independent pressure oil film between its rubbing surface and the shaft, the number of the pressure oil films can be increased, so that the full projected surface of the bearings becomes effective for carrying load, and the brake surface is eliminated. The friction is thus reduced, the load-carrying capacity increased, and the bearing shortened.

Michell Journal Bearing Tests

A series of tests has recently been run on a Michell journal bearing by Cammell, Laird & Co., Birkenhead. Figs. 5, 6 and 7 show details of the experimental bearing, and Figs. 8 and 9 the method of testing it. As will be seen from Fig. 5, the bearing surface is divided into 12 segments, each of which is pivoted on a rib at its back, so that it is free to lift at its leading edge to allow the necessary wedge-shaped oil film to form. These segments are shown in detail by Figs. 10 and 11. The faces of the segments or blocks are lined with white metal, each surface being 2 in. square, giving 48 sq. in. of rubbing surface, the equivalent projected area of each half of the bearings is 16½ sq. in.

In addition to the segments being free to tilt, the seat on which they rest is partly spherical, thereby making the bearing also a swivelling one. A circulation of oil was passed through the bearing, entering it between each pair of blocks from the chambers A and B, and escaping at D. The bearing was driven by means of an electric motor, and the ammeter and voltmeter readings recorded. Each run was continued until the temperatures of the oil were also recorded, together with the weight of the oil passing, and the revolutions per minute. The load was applied by adding weights to the scale pan H, shown in Fig. 9, the leverage being 11 to 1.

The annexed table gives the results observed, together with the friction calculated from the heat taken up by the oil. The friction is that for the two halves of the bearing pressed together. To get the coefficient of friction these figures require to be divided by twice the load.

LARGE POWER CHAIN DRIVE

A CHAIN DRIVE of 5,000 h.p., said to be the most powerful chain-drive gear in the world, is in operation in a hydroelectro plant on the Snake River in Oregon. Two water-wheel shafts, which make 149 revolutions per minute, are connected by four driving chains with a generator shaft that is driven 225 revolutions per minute. Each of the former shafts carries a 71-tooth sprocket wheel, 45½ ins. in diameter, and the generator shaft has two 47-tooth sprockets, a little over 30 ins. in diameter. The waterwheels drive sets of four chains, each of which is over 31 ft. long, 21 ins. wide, and weighs 2,800 lbs. The chains have been tested to a strain of 40,000 lbs. per sq. in., though ordinarily the tensile strain is 600 lbs. A chain drive was not contemplated for this plant originally, but in the midst of its construction, and afer part of the machinery had been delivered, financial difficulties interrupted the work. After some time experts recommended the chain drive as the most economical means of utilising the available equipments.

* * *

COAL SELECTION

IF you have selected a coal which is too good for the work required, you are not only paying more per thousand units of heat than you would have to pay for a lower grade coal, but you probably have to turn the high-grade coal at an inefficient rate of combustion which adds still more to your loss. You must have a coal of sufficiently high heat value to do the work, but to do more than this is not economy. Many plants are influenced to buy too good coal because they like perfect peace in the boiler room. Peace at any price in the boiler room may be pleasant but it is usually expensive. The boiler plant of most factories is not intended as a rest resort for firemen, although coal selection in many plants seems to be determined more on the basis of the firemen's comfort than economy in the production of power. This disturbing element in coal selection can only be eliminated by establishing definite standards of firing conditions, and furnishing the firemen an incentive to maintain or better those standards. Under such conditions, the firemen will understand that their sole duty is to fire in the most efficient manner any coal that is selected for them.

* * *

ESTIMATING METAL TEMPERATURES BY COLORS

THOUGH the use of pyrometers in furnace work has greatly increased of late years, there are certain conditions under which they cannot be applied and it is then necessary for the operator to be guided by the eye. The following tables, given in the Foundry Trade Journal will be found useful as a general guide to the relation between temperature and appearance.

	Deg. C.	Deg. F.
First visible red	525	977
Dull red heat	700	1,292
Turning to cherry	800	1,472
Actual cherry red	900	1.652
Bright cherry red	1.000	1,832
Dull orange	1.100	2,021
Bright orange	1,200	2.192
Bright orange	1.200	2.192
White heat	1,300	2.372
Bright white heat	1.400	2.552
Dazzling white heat	1.500	2.732

Tempering and Hardening Tools

	Deg. C.
Light straw	220 to 230
Dark straw	240
Yellowish brown	255
Reddish brown	265
Purple	275
Violet	285
Cornflower blue	295
Pale blue	310 to 315
Sea-green or grey	330

TEST OF EXPERIMENTAL "MICHELL" JOURNAL BEARING. MAY, 1916.

Date and Duration of Test.		Total Load	Bearing Pressure	Revs. per Min.	Surface Speed	Amperes	Volts	Horse-Power Input	Oil Supply Final Inlet Temp. F.	Oil Supply Final Outlet Temp. F.	Oil Supply Rise of Temp. F.	Oil Supply Flow of Oil.	Friction Horse Power from Heat to Oil	Coefficient of Friction	Actual Friction
May	Mins.	Lb.	Lb. per sq. in.		Ft. Min.				Deg.	Deg.	Deg.	Lb. Min.			Lb.
18	45	....	...	585	1,840	16.5	406	9.2	68	84	16	12.6	1.9	......	....
18	105	2,400	145	620	1,950	14.5	403	7.9	79	99	20	14.8	2.8	0.0099	47.5
18	105	3,600	220	615	1,930	16.0	395	8.6	84	101	17	14.3	2.3	0.0054	39.2
19	60	4,800	290	605	1,900	16.6	382	8.6	83	100	17	15.6	2.5	0.0045	43.7
19	40	6,000	370	615	1,930	16.9	395	9.1	84	102	18	17.6	3.0	0.0043	51.6
19	75	7,300	440	607	1,907	18.9	391	10.0	84	102	18	18.7	3.2	0.0038	55.4
19	45	8,500	520	605	1,900	19.0	395	10.2	83	99	16	19.0	2.9	0.0029	50.1
19	60	9,800	600	618	1,940	20.4	395	10.9	71	93	22	19.0	4.0	0.0034	67.6
20	90	11,700	700	611	1,920	21.0	391	11.1	76	100	24	19.7	4.5	0.0033	77.2
20	30	14,800	900	620	1,950	26.5	400	14.4	77	102	25	22.7	5.4	0.0031	91.7
24	30	....	...	1,315	4,130	23.0	390	12.2	76	95	19	23.0	4.1	......	....
24	60	2,400	145	1,320	4,140	27.8	392	14.8	74	96	22	26.4	5.5	0.0091	43.7
24	45	5,500	320	1,320	4,140	29.8	390	15.8	77	104	27	25.2	6.4	0.0046	51.1
24	60	8,500	520	1,303	4,100	40.0	398	21.6	82	117	35	33.0	10.9	0 0051	87.5
25	60	11,700	700	1,324	4,140	50.0	382	26.0	76	111	35	37.3	12.2	0.0042	98.3
25	105	11,700	700	1,317	4,140	42.0	390	21.2	73	112	39	31.2	11.5	0.0039	91 2
25	30	14,800	900	1,320	4,140	45.5	400	24.7	76	117	41	33.0	12.7	0.0034	100.4

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Vol. IX NOVEMBER, 1916 No. 11

EXHIBITION OF ENEMY PRODUCTS AT TORONTO

WHILE it is meantime impossible to fully estimate results likely to accrue from the two-week period during which samples of enemy products were on exhibition in Toronto, there is little doubt that some useful missionary work has been done in the matter of directing the attention of our manufacturers to the value of export business, and in bringing vividly before them the wide variety of trade openings available in overseas markets. To what extent steps will be taken by Canadian industries to share in the different offerings remains to be seen, nevertheless in view of the intelligent interest aroused, and notwithstanding such immediate disabilities as high production cost comparatively, and lack of our own merchant marine, definite, even if slow and modest, progress may be expected. Not a few manufacturers visiting the Exhibition and who had been exercising themselves with regard to the possibilities of doing business in foreign markets expressed their intention of taking up the proposition seriously as a result of what they had seen. Others again were able to appropriate ideas from different exhibits which would help them to modify existing production methods, and thereby more effectually embrace home market opportunities, if not those abroad.

The total attendance at the local Exhibition was 2,620, making the third highest in point of numbers of all the cities visited in the United Kingdom and Canada. The various attendances to date are as follows: Manchester, 3,491; Birmingham, 3,341; Toronto, 2,620; Glasgow, 2,014; Montreal, 1,714; Sheffield, 1,203; Dublin, 1,173; Leeds, 1,149; Liverpool, 1,079; and Nottingham, 1,050. Leicester and Bristol were both under the thousand mark. The attendance at Toronto included, of course, visitors from outside towns, such as Hamilton, Guelph, Kitchener, Galt, London, Peterborough, etc. In the totals of all of the cities named, the surrounding districts are of course also included. A circular entitled, "Questions for Canadian Manufacturers" was distributed at the Exhibition on behalf of the Department of Trade and Commerce, Ottawa, the response to which has so far been quite gratifying. A considerable number of the circulars have already been filled in and returned to Ottawa for attention. A week's stay in London, Ont., commencing Nov. 20, followed by a like period in St. John, N.B., completes the programme so far as Canada is concerned. With the evidence before it that a display of exceedingly cheap, varied class and flimsy natured products merited a keen and widespread interest on the recent occasion, it behooves our Department of Trade and Commerce to immediately plan for an even larger display, and that of more substantial enemy products in the near future, bearing in mind particularly the lines through which Germany cemented her hold on our own home market. Power plant equipment and auxiliary apparatus formed no inconsiderable part of the latter.

RISING PRICES OF POWER SUPPLIES.

WITH the increased activity developing in the munitions industry here and elsewhere, prices of raw, semi-finished and finished commodities for manufacturing and power plant services continue to stiffen materially. The coal situation has become specially acute in recent weeks, prices of hard and soft coal, as we go to press, being quoted at $9 and $8.50 per ton respectively, due to labor shortage at the mines primarily, and in some degree to the lack of transportation facilities.

Prices on general supplies continue very firm and some lines have advanced. Makers of leather belting have raised their prices, the new discounts being as follows: Extra heavy single and double, 30 and 10 per cent., standard 40 per cent. Cut leather No. 1 is now $1.40 and leather insides $1.20 per pound. Cotton waste has advanced, the range being from ¾c. to 1¼c. per pound, according to quality. An advance of 10 per cent. on gasoline and refined oil storage tanks is expected in the near future. Soldering irons have advanced and are now quoted at 61c. per lb., base.

Prices of oil and gasoline have been revised to suit a new method of selling, gasoline being now sold in bulk with an extra charge for barrels or cans. The new price for gasoline is 26½c., and for benzine 25½c. per gallon in bulk. There has also been a change in some lighting oils and cutting compounds. Castor oil is lower at 23c. per pound, while "Royalite" is also lower at 10½c. per gallon in bulk. Fuel oil is a shade higher at 2¾c. per pound.

COST AND VALUE OF TRADE AND TECHNICAL PAPERS.

ONE effect of munitions manufacture by Canadian metal-working plants that daily comes under our notice is the intelligent interest being taken by operators—yes, and by executives, in the outputs of kindred establishments, and the methods, devices and scheduled routine by which specific results are being achieved. In no direction is the interest more apparent than in that relating to our subscription personnel — numerical and otherwise. A higher cost of knowledge of one's trade or profession has, like the high cost of living, thrust itself to the front, due, of course, like the latter to a combination of circumstances, avoidable and perhaps not.

Sources of knowledge are not circumscribed, neither are its demands, in consequence centralization of the former for distribution becomes necessary, and printer's ink and paper are the mediums of accomplishment. Each of these commodities has been caught in the swirl of the universally prevailing abnormally high prices, cost of knowledge distribution having in consequence to follow suit. Whether in pre-war days the low cost at which up-to-date information in a trade and technical journal was assessed at its true value, by subscribers or otherwise, is now of little moment, because of the greater appreciation, due to the enlarged outlook, now being displayed; the relatively determining evidence being that of the alertness with which increased subscription rates are being responded to by those concerned. The cost of developing one's intelligence and aptness to pursue successfully a chosen trade or business career is still well removed from such a classification as "high."

The Operators' Point of View

POLYPHASE INDUCTION MOTOR TROUBLES CAUSED BY SINGLE PHASING

By Sydney Rose.

PERHAPS one of the most frequent causes of "burn-outs" in polyphase induction motors is that of single-phasing, this happening more frequently in smaller size motors than in the larger ones, because the latter are generally better protected by relays and no voltage releases which cut off the current from the machine in case of trouble. Common sources of single phasing are the blowing of a fuse, and poor or broken switch contacts. Small polyphase induction motors are generally started by means of a switch which connects the motor directly to the line, or by means of a double-throw switch and a set of fuses for the starting and running positions, the set for the starting side being of greater capacity than those of the running side.

This method of starting with a double-throw switch and two sets of fuses gives the motor a better protection than the use of one set of fuses and a switch connecting the motor directly to the lines, because when this means of starting is employed the fuses must be capable of handling the starting current, which may amount to 2½ to 3 times full load current. Again, when such an arrangement is used, it is easily seen that, should one fuse blow, considerable damage or a "burn-out" will result before the other fuses blow and cut off the machine from the supply. Of course, such an eventuality may be easily guarded against if the motor be located where the engineer or other person in charge can cut it out of service.

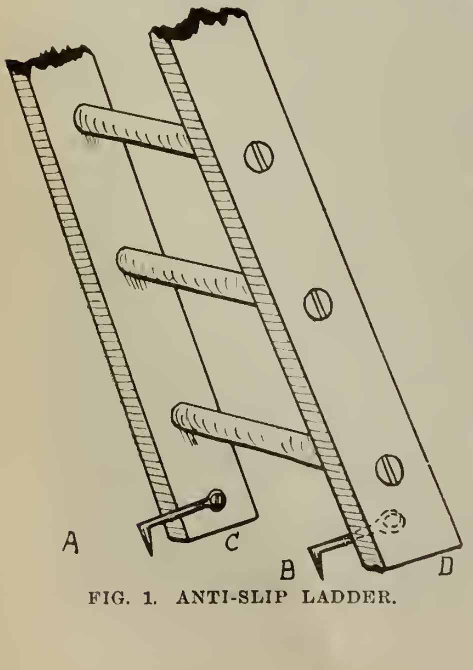


FIG. 1. ANTI-SLIP LADDER.

Many small induction motors are installed in remote places where the operator in charge cannot see them, and, in such cases, care should be taken to see that all the switch contacts and fuses are in first-class order. Sometimes small polyphase induction motors are used on dumb-waiters and other classes of service where the machine is out of sight. Such motors are generally fused to allow for the starting current. Should one fuse blow and the machine fail to start, and if for the want of knowing better the controller be left in running position, the motor is likely to be burnt out before the other fuses blow. Of course, this trouble can be overcome by installing a relay arranged to cut all lines from the motor should necessity arise. The relay will be of the time-limit type so that it will not throw out on the momentary starting current. There are many such relays on the market, and their use for such purposes is recommended.

Another cause of trouble in induction motors which may be mentioned here is that of flooding the bearings with oil in such a way that the oil gets on the windings, and so causes a breakdown of the insulation between phases or from the windings to the frame of the motors. Care should be taken not to allow the oil to overflow, and, should any be spilled, it should be promptly cleaned off with a rag or waste; otherwise trouble is sure to result later. The greater part of the troubles with induction motors may be traced to some of the above defects.

* * *

ANTI-SLIP LADDER FOR TILE OR WOOD FLOOR

By J. E. Noble.

MAKE two hooks, as shown at A and B, Fig. 1, and fasten them to the ladder ends tightly with screw nails. When using the ladder on a rough wooden floor pull down the hooks and tap the point into the wood with the heel of your boot, and the ladder will be then absolutely safe.

For using a ladder on tile, polished wood, or any other smooth floor, nail a piece of sheet rubber (a piece of old auto tire or rubber fire hose will answer) on the bottom of the ladder legs at C and D; shown at E, Fig. 2. The two ideas can be used in combination on one ladder, if desired.

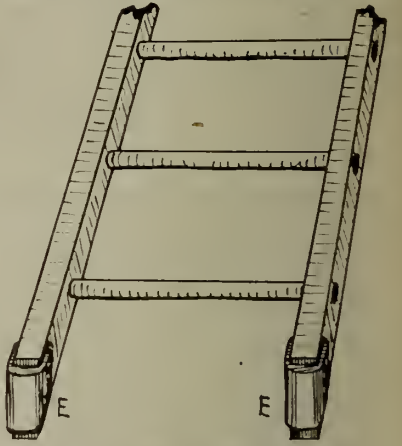


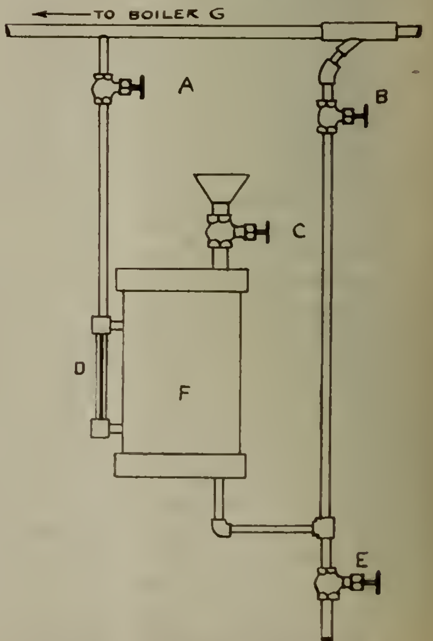
FIG. 2. ANTI-SLIP LADDER.

* * *

BOILER COMPOUND FEEDER

By J. Thorn.

ALTHOUGH numerous boiler compound feeders have been described and illustrated, the sketch and data of one here-



BOILER COMPOUND FEEDER.

with have several features of interest which have not come to my attention before. The pipe G is the feed from the pump to the boiler; F the compound holder made from a 4-in. or 5-in. nipple and two caps; D is a glass tube connected to the holder with two ordinary expansion tank fittings, and E is a draw-off cock. To make connection, use a half tee Y and a 45-degree elbow as shown. To fill compound holder, first draw off all the water at E, valves A and B being closed and C open. Next close E and fill the holder through the funnel at C, afterwards close C and open B. When the pump is running, the valve A can be opened slightly and the compound will feed slowly.

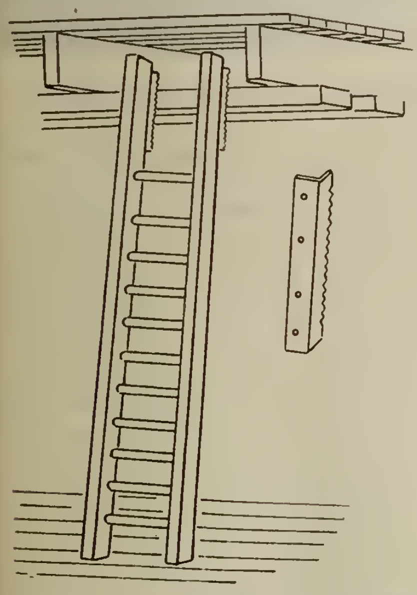
The compound does not pass through the pump to affect the packing, and it can be fed slow or fast as desired. The apparatus is practically fool-proof and is about as simple in detail and arrangement as can be devised; any engineer or fireman can put it together.

* * *

MAKING THE SHOP-LADDER SAFE

by A. D. I.

AMONG the many kinds of industrial accidents that occur in factories, none are perhaps so common and have such serious and fatal consequences, as those due to slipping shop-ladders. While a great deal of study has been given to render these safe, most of this attention has been given in providing means in having the feet of the ladder properly equipped with rubber or steel-pointed shoes.



SAFETY DEVICE FOR TOP END OF SHOP LADDERS.

Watch the Top

It never occurs to anyone that the top of the ladder, where so many exertions take place by workmen in doing overhead work, requires suitable equipment of some kind to prevent ladder from swaying from side to side. For as everyone knows who has had occasion to use one, a ladder, whenever placed against a stringer will seldom remain in position while one is standing on it, and workmen, are obliged to take hold of a stringer with one hand in order to hold the ladder steady, by which they are greatly handicapped in handling tools, etc.

In the accompanying illustration, is shown an easily made simple attachment, that can be fastened to the top of any shop-ladder, which will prevent them from swaying sideways, and also from slipping outward at the feet as usually happens. Referring to the sketch, two short strips of 1¼ in. angle-iron, having several teeth notched in on one side, are screwed in at the back of the ladder at the top as shown. When the ladder is placed against a stringer, the teeth become imbedded in the wood, causing the ladder to hold firm when so placed. There is little possibility of the ladder moving, and workmen can freely use both hands when working overhead.

Shop ladders are nearly always standing upright against walls and beams, owing to the less room they take up. As is well known these are often jarred against belts and pulleys and have to be constantly watched. In the adoption of this attachment this will hereafter be unnecessary, and also ladder accidents will be greatly checked, and less frequent than they are now.

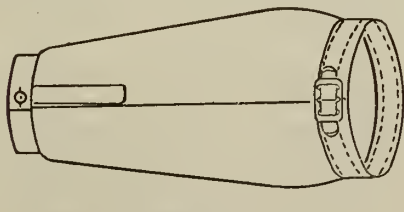
* * *

A SLEEVE HOLDER KINK

by J. Wright

ENGINEERS and others who are in the habit of wearing sleeves at their work, have always experienced trouble in keeping these held up on the arms, for as soon as the elastic contained inside the band around the top of the sleeve becomes stretched a little, the sleeve becomes loose and is constantly slipping down.

In the enclosed sketch, is shown a useful kink, wherein this trouble is overcome. A pair of adjustable sleeve-holders or armlet-elastics are placed inside the sleeve band, having the buckles protruding out as shown. When the sleeve becomes loose, it is only necessary to take up on the elastic by pulling the ends through the buckles.

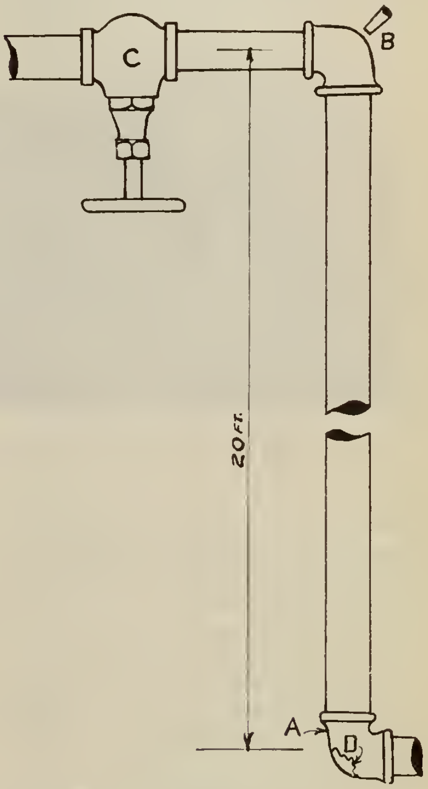


USEFUL IDEA FOR HOLDING SLEEVES.

REPLACING CRACKED ELBOW UNDER STEAM

By J. E. N.

THE following kink may help out some one under similar circumstances:—A 3-inch steam pipe had the stop valve C in the line as shown. The elbow at A had to be removed, as it was cracked at D. When the valve C was closed it leaked so much as to make it impossible to remove the elbow without turning the steam off at the main valve on the boiler. This could not be done at the moment. As a way out of the difficulty, the engineer ran the one-inch cold water hose to the point B, turned on the water, and allowed it to flow down the pipe, thus condensing the steam passing the valve C. Although the job was wet, it was not hot. The cracked elbow was removed satisfactorily, and a good one put in its place with equal success. This is no imaginary happening, it having actually occurred in the writer's experience.



REPLACING CRACKED ELBOW UNDER STEAM.

* * *

CANADA'S FIRE LOSS A NATIONAL HANDICAP

IT is perhaps not fully realized by all the advocates of foreign trade expansion that Canada, by reason of the enormous proportions of her fire loss, will find it increasingly difficult to meet the competition of lower-priced labor in Europe. A contributor to *Conservation* for October, calls attention to the excessive cost of fire protection in this country and the manner in which it is bound to retard that future development now so hopefully looked forward to:—

The fire loss of Canada has reached enormous proportions. The drain upon her financial resources constitutes an economic loss which no country can afford and still meet competing nations on an equal footing. The war has had far-reaching effects upon commerce. European countries, in greater or less degree, are realizing their latent powers, production is being speeded up, resources are being developed, trade openings are being sought and established. Prior to the war, Canada found herself handicapped in any scheme of trade expansion by the lower cost of production in Europe. It therefore follows that, with the realization by European countries of their commercial possibilities, this trade handicap will be greatly accentuated.

On the basis of averages, and from the data available as to the cost of insurance and upkeep of fire departments, the following comparisons may be deduced:—

For the past three years the average rate for fire insurance in Canada has been $1.18 per $100 of insurance. The average rate in Sweden is .40, in Austria .30, in England .23, in Germany .22, in France .21, in Spain .19, in Italy .19.

A Canadian employer of labor with 100 employes, carrying an insurance of $50,000 on plant and buildings, and, assuming that $2,000 insurance is carried or paid for by each employee on furniture and dwelling—or a total of $250,000—would, on the foregoing basis, have to provide in wages and overhead charges $2,950. His competitor in Sweden would only require $1,000, in Austria $750, in England $575, in Germany $550, in France $525, in Spain and Italy $475.

For upkeep of fire departments Canada is heavily taxed in comparison with competing countries. In 1914, Paris, France, with a population of 2,846,986, had a total fire department expenditure of approximately $656,479, or 23 cents per head. Toronto, for the same year, with a population of 470,144,, spent $675,146 on her fire department, equal to $1.43 per head.

WHAT A BOILER INSPECTION REVEALED

TO a factory in Ontario, the Provincial Government boiler inspectors were recently called to examine a battery of old boilers that were again to be put in operation. It is a fortunate circumstance that inspection was required, for the boilers were in such shape that they would surely have blown up if put into service in the condition in which they were found. No previous inspection had been made by the provincial authorities. It was believed that extensive repairs would be necessary before the boilers could be used again, and, because of this, they automatically came within the jurisdiction of the steam boiler branch of the department of Public Works, Province of Ontario. Inspection revealed the condition of all three boilers to be such as to necessitate their removal and replacement by new units. Adhesion of oil to the bottom shell plates appears to have been the undoing of the different boilers. The illustrations taken from the worst of the three after removal from the brickyard setting speak for themselves. All three boilers were of horizontal, return tubular type, 72 inches diameter and 18 feet long.

The exhaust steam from the engines was discharged as condensate into a hot well, being afterwards pumped back without filtration into the boilers. In consequence, a considerable quantity of the oil and grease used for lubrication in the engines was carried into the boilers along with the feed water, and, after combining more or less with the sediment held in solution by the water, formed a greasy deposit which settled on the heating surfaces, preventing the water from coming in contact with the plates, besides interposing a poor conductor of heat transmission, the result being that the plates became red hot and bulged. It is noteworthy that all three boilers comprising the battery were bulged, although two of them were so to a lesser extent. The development of the bulges may have been gradual, yet when discovered, all the boilers were in a dangerous condition.

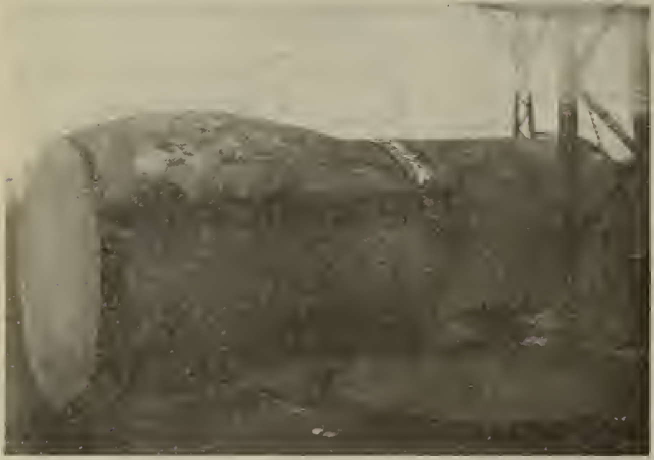


FIG. 1—BOTTOM UP VIEW OF BOILER SHOWING BULGED CONDITION OF LOWER SHELL PLATES

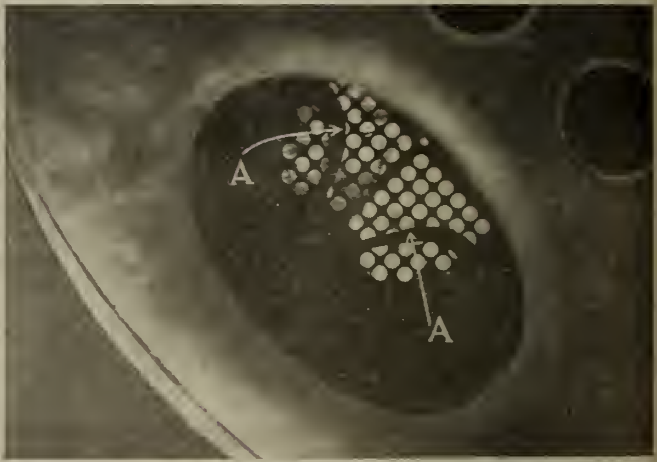


FIG. 2—VIEW THROUGH FRONT HEAD MANHOLE BELOW TUBES SHOWING BENT LONGITUDINAL STAYS.

Fig. 1 shows the deformation of the bottom shell plates of one of the boilers. The bulge extended half way round the circumference, and showed 22 ins. extreme depth. The plates had stretched circumferentially about 30 inches.

Fig. 2 is a view taken through the manhole door below the tubes on the front head and shows how the longitudinal stays a bent when subjected to compressive stress, due to the boiler head around the manhole being pulled in when the shell plates bulged outwards. The inside lap of the girth seam at this point was about one inch clear of the bottom shell plates, and the head was distorted about seven inches from its original face line. It was fortunate that the bulged plates remained intact, and their having done so proves that the material 7-16 in. thick, must have been of very good quality.

We are indebted to D. M. Medcalfe, chief boiler inspector, Province of Ontario, for the data and photographs.

* * *

Out in California a centrifugal blower, driven by an electric motor, is being used in the shelling of almonds. Formerly the nuts could be shelled by hand only with the greatest difficulty. At the present time the almonds are feel into the suction side of the fan, where they are picked up by the runner and hurled against the fan casing, following which they are blown out of the dischorge pipe into a box, already shelled

Operators' Instruction Course

INDICATOR BRIEFS

IN any indicator, the piston should always fit the cylinder loosely enough to allow the steam to blow past it. This is important, whether the instrument be used at high or low speeds. With regard to errors that may arise from leakage past the piston, it should be clearly understood that leakage, unless it be sufficient to add to the atmospheric pressure above the piston, cannot affect the accuracy of the indications. Absurd devices have been patented for keeping the piston tight, says an authority, while the one thing really needful is to secure absolute freedom of piston motion. It is suggested that two short elbows of brass pipe, not less than $\frac{1}{8}$ inch bore, be screwed into the indicator cylinder cover, so as to allow free passage for such steam as may leak past the piston. The elbows should, of course, be turned so as to direct their discharge away from the card drum. If a piston leaks, the accuracy of the pressure reading will be affected if there is not provided a free escape for the leakage.

The use of a long indicator connecting pipe may cause quite an appreciable addition to the clearance volume of an engine cylinder, especially in the case of small engines. Where the connecting pipe has a bore of, say, $1\frac{1}{2}$-inch, as is common, and suffers no contraction up to the indicator tap, the difference of pressure between the two sides of a piston as recorded in the indicator diagram will be quite inappreciable, provided the bore of the two-way cock is quite $\frac{3}{8}$ ins.: a bore of something like half this may, however, introduce serious error.

If the expansion corner of an indicator diagram is much cut away, the engine is working to a proportionate extent expansively.

If the exhaust corner is much cut away or slanted, the exhaust passages are too small.

If the lead bottom right-hand corner of the diagram is much slanted off, then the engine lead is large, the steam side of the valve is opened before the end of the stroke, or the exhaust passage is closed too soon, which causes compression.

In some cases the vapor may be compressed beyond the pressure of the steam in amount and cause the diagram line to form a loop above the steam line at the admission corner.

If the admission corner is slanted much, then the steam is not admitted sufficiently early.

* * *

STEAM BOILER BRIEFS

LEAKAGE through brickwork settings can be lessened by giving the walls two coats of Portland cement wash, followed by one coat of cold water paint to brighten them up.

In water tube boilers, the heating and grate surface should not be less than a 50-to-1 proportion respectively, the type and also the height of the same class boiler often necessitate, however, a considerable variation of the above. With cylindrical boilers, one-third of this can be used, because the ratio of evaporation per sq. ft. of heating surface is approximately for water-tube type 3.5, and for cylindrical type 10: therefore $\frac{10}{3.5} = 2.86$, say, 3.

The area and air spaces of fire grates vary with the class of fuel to be burned. Hard coal can be burnt on ordinary grates; slack requires larger grate area but smaller air spaces, while wood requires both larger grate area and larger air spaces comparatively.

Small diameter tubes provide greater heating surface and give increased evaporative efficiency in a given space, but are disposed to foul quicker than those of larger diameter.

Water softening provision for all types of boilers cannot be too strongly urged, an efficient type of water softening apparatus installed making for certain economy. Less than three degrees of hardness by Clarke's scale should not, however, be pressed.

The value of large steam room is greatly over-rated, yet if too small, the steam—particularly at high pressures—will sweep up the water in the form of spray and cause priming. Other causes of priming are foul water and operating with too high a water level. Too much water space makes for slow steaming and consequent waste of fuel at starting, but provides a great reserve of steam for sudden calls.

LUTES, AND SODA ASH

THE Question and Answer Series as well as the General Section contents of each issue of THE POWER HOUSE are receiving the close attention of its readers, as the accompanying references and the article by W. B. P. on Scale Removal amply demonstrate.

We notice on page 273 of the October issue of THE POWER HOUSE that white lead and red lead are stated to be the best materials for luting threaded joints. The correct answer, in my estimation, should have been Dixon's graphite pipe joint compound.

On page 274, same issue, it is stated that soda ash should be used to treat scale, as it causes the solid matter to deposit in the form of a soft mud, which may be gotten rid of by frequent blowing-off. This may be true in theory, but never in practice, in my experience at least. Flake boiler graphite is the most commonsense and satisfactory treatment to apply, for, while it only partially prevents scale forming, it makes the latter easier of removal, which is at least equal to the accomplishment of most chemical compounds. I am quite well aware that the views here expressed are liable to be criticized just as I have done, still "the proof of the pudding is the eating of it," and what has been said comes from good "digestion," so to speak.—S. L. H.

* * *

CLEANING BOILERS AND SCALE REMOVAL.

By W. B. P.

IN your October issue I find under the general heading Electricity and Hydraulics an article by W. Kavanagh entitled Care and Management of Steam Boilers in the Central Station Plant. In discussing the question of cleaning boilers and removing the scale, Mr. Kavanagh illustrates and describes a method of cleaning boiler tubes, the superficiality of which is exceeded only by its antiquity.

According to the method described by Mr. Kavanagh a rod or bar is run into the boiler between the tubes and all loose scale with which it happens to come into contact is brushed off the tubes, falling to the crown sheet of the boilers.

After this scale removal (?) has been successfully accomplished, a stream of water is played between the tubes. It is claimed that all or nearly all of the scale will be thrown down on the crown sheet from whence it can be removed by means of a long handled hoe.

When one comes to consider that in the average steam boiler where scale accumulates to greater or less degree, th deposit becomes as hard substantially as solid rock, and cements itself to the tube wall even more closely than does the time honored porous palster, it may be seen that the method described would hardly serve for a plant where thorough scale removal is desired. By Mr. Kavanagh's method all of the loose scale or at least a part of it will of course, drop to the crown sheet, but it is absolutely impossible for anyone to remove more than 5 per cent. or 10 per cent. of all the scale on the tubes by means of a bar and a stream of water.

The principal reason for this is first, the hardness and tenaciousness of the scale mentioned above; second, because it is practically impossible to reach every part of the tubes; and third, because the operator cannot see between the tubes, and has absolutely no means of knowing whether his bar is knocking off scale or not.

Imagine if you can, a pane of glass upon which a good coating of paint has had plenty of time to dry thoroughly. Then imagine blindfolding a man, putting a knife into his hand and telling him to scrape that paint off. The only difference between this illustration and Mr. Kavanagh's method of scale cleaning is that a great deal more paint will be scraped off the glass than comes off the boiler tubes.

Mechanical Cleaners Only Efficient

Without mentioning any particular method or device, it may be stated as practically axiomatic that the only sure way to remove scale is to use a mechanical cleaner—a tool that is especially designed to get the scale off and get it off thoroughly. In this connection the manufacturers of the B. & W. boilers in their book called "Steam", have the following to say. "***for, though a rapid circulation of water in the boiler will delay the scale deposit, and certain chemicals will change its character, the most certain cure is periodical inspection and mechanical cleaning."

It is folly to talk about cleaning boiler tubes or about scale removal unless the scale is entirely removed. A part of the scale still adhering to the boiler tubes after the cleaning has been supposedly accomplished will just as easily and quickly overheat and burn out the flues as though the deposit were half an inch thick. All of the scale must be gotten off the tubes if steaming is to be improved and if the tubes themselves are to be preserved against decay.

There is still a fair percentage of engineers who do not realize fully the damage that scale can and will do. They seem to regard it as a nuisance, but nothing of any serious importance. If these men knew and could only have it proven to them as it has been proven to thousands of others that scale causes more damage, kills more men through tube failures and explosions, and wastes more fuel than any other one thing connected with the operation of steam boilers, they would regard this condition more seriously than they do at present.

Light Scale Coating Fallacy

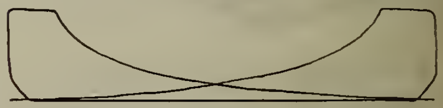
There are some engineers who say that they think a light coating of scale on their boiler tubes is a good thing; that it prevents the tubes from pitting and corroding. This is an erroneous conception. Although it is probable that a thin layer of scale will prevent the pitting of the tubes, the overheating and burning out of the tubes is far more serious, and the loss in fuel consequent upon the presence of the scale more than makes up for the slight advantage that this condition is supposed to give. The manufacturers of steam boilers to-day are as anxious as the purchasers and operators of those boilers to produce a perfect boiler ,and if a thin coating of scale on the tubes was regarded as a good thing the chances are the manufacturers would put that coating on the tubes before the boilers are installed; but the fact of the matter is they know that nothing should interfere between the heat from the furnace and the water in the boiler excepting the tube wall itself, and realizing this fact, supply only clean and new tubes.

The writer is moved to make the foregoing statement because he feels thot there are many readers of your paper who would doubtless adopt Mr. Kavanagh's method of scale removal under the erroneous impression that it would produce satisfactory results.

* * *

Coal Consumption.—We use about two tons of coal per day of 10 hours, same being partly chargeable to our shop heating system and partly to our engine, indicator diagram from which is shown. The engine is single cylinder Corliss type, the cylinder being 14 ins. diameter by 30 ins. stroke; revolutions per minute 78, and working pressure 70 pounds per sq. inch. The piston rod is 2 ins. in diameter, and the scale of indicator spring 40 pounds per inch. I want to know the indicated horse power developed, also how much coal is chargeable to the engine.—G. E.

It may be stated at the outset that no atmospheric line appears on the diagram. Care should be taken to register this first in all cases ,as by so doing it is less liable to be overlooked altogether. The mean pressures are 11.50 and 13 at the crank or left side, and at the head or right side, respectively of the diagram. The mean pressure during a complete revolution is therefore 12.25 pounds.



INDICATOR DIAGRAM. COAL CONSUMPTION QUERY

Indicated Horse Power (I.H.P.)=

$$\frac{2\times12.25\times2.5\times152.5\times78}{33000} = 22.$$

Assuming that the engine uses 35 pounds of water as steam per horse power per hour—this we should judge as being about its rating, and that the evaporation per pound of fuel is in the neighborhood of 7 pounds, we get 35/7= 5 pounds of fuel per horse power per hour, or 5×22×10=1100 pounds of coal per 10 hour day. From the foregoing it will be seen that the major portion of the coal used is chargeable to purposes other than the engine.

* * *

Stack Height.—We intend putting up a new steel smoke-stack, and information is requested as to its height. We have two boilers each 66 ins. diameter and 14 ft. long. The grate area of each is 25 sq. ft. The stack, 30 ins. in diameter will be located about 14 ft. away from the boilers, with two elbows intervening. Only one boiler is used at a time. In my opinion the height should be 80 ft., but my firm say that 50 ft. is ample. What opinion have you to offer?
—C. F.

In view of the circumstance that only one boiler is in service at one time, but assuming that same operates at or near its commercial horse power rating, which we judge is somewhere around 80, a stack of 50 ft. in height appears to be a reasonable proposition for a diameter of 30 inches. The location of the stack relative to tall buildings which might interfere in measure with the draught, and in addition be subject of more or less smoke nuisance, fall to be considered in otherwise determining the height.

Question and Answer Section

Transformer and Switch Oils.—Although we have had little trouble to speak of with our transformer equipment, I understand that other experiences are not quite so satisfactory. I have been inclined to blame the oil constituent more than the apparatus for heating troubles and should like to have an expression of opinion on the matter. —C. M.

Transformer and switch oils are probably too little understood by the average engineer, many of the heating troubles experienced being due not to the apparatus but to the oil, a very slight adulteration of the latter making for trouble. Moisture, even to the extent of five or six drops of water per quart of oil, reduces the insulation by about 25 per cent. Sulphur, resin, acid and alkali, which are found in some oils, also have a very bad effect, while the formation of carbon and sludge takes place even in the best oil. The way to avoid these troubles is to buy the oil to strict specification, anl to have it properly tested before use. Tests at frequent intervals should also be made, while the tanks should be cleaned out at least once every year, and the oil changed, or at least filtered, at the time.

* * *

Steam Jacketing Engine Cylinders.—Are steam engine cylinders now equipped with steam jackets to as large an extent as they were say fifteen or twenty years ago. It seems to me that such is not the case. What is the ideal aimed at in steam jacketing?—H. T.

In practice, steam jackets are now rarely used except on small or on slow-speed engines, such as waterworks pumping engines. The function of a jacket is to supply heat so as to raise the average cylinder wall temperature in contact with the working steam with a view to reducing initial condensation. To do this, the jacket steam should be hotter than the working steam, and, in order that the heat transference may be effective, the steam should pass through the jacket at a moderate speed. Both these conditions are commonly ignored when jackets are fitted, the usual practice being to reduce the steam to but little more than the valve chest pressure and lead it into the jacket with no proper blow through except that provided by a steam trap.

* * *

Generator: Drying Out.—When a direct current generator has become damp from one cause or another, what means should be employed to dry it out quickly and satisfactorily?—J.R.

Replying to the above query, the answer given in a recent issue of the *General Electric Review* is, we think, both clear and complete. A simple shunt machine should have its field opened and its armature short-circuited by a cable which will carry two or three times the normal armature current and which is also of sufficiently low resistance to constitute a "dead short-circuit." When a generator of standard design is driven at normal speed under such conditions the residual magnetism will cause a circulating current to flow in the armature, its value being between normal full-load current and twice this amount, which is a good working value for drying out. Should it be found that the residual magnetism will not cause a sufficient current flow, the shunt field should be very weakly excited from some external source. The low field current necessary can be obtained either from a very low voltage source direct or from an ordinary voltage source by inserting a high resistance in the field circuit. If severe sparking takes place at the commutator when operating under these conditions it can be minimized by giving the brushes a forward shift. Ordinarily enough heated air will be thrown off the rotating armature to dry out the field. In case this proves to be insufficient, or only the field is damp, heat can be localized in the field winding while the machine is at rest by connecting the spools to an external source of excitation. From one-quarter to normal voltage should be applied depending on the dampness of the spools. It has been suggested that a machine can be dried out by applying alternating current to the field winding while the armature is short circuited. This method is open to the serious objection that the alternating flux will cause excessive heating in those parts of the magnetic circuit which are not laminated.

A commutating pole machine that has no series field winding should be dried out in the same manner as described for a simple shunt machine. Care should be taken that the brushes are not back of the neutral but are slightly forward of it. The commutating-pole winding is to be wired in exact accordance with the standard diagram of connections for operation; and the short-circuit placed on the machine is to include the commutating pole winding as well as the armature.

A compound machine should be dried out as described in the foregoing except that the series-field winding should be cut out of circuit entirely. This latter is a precaution to prevent the possibility of the machine building up as a series generator in case no external excitation is applied to the shunt field.

* * *

I. H. P. from Diagrams.—Will you kindly calculate the indicated horse power from each of the accompanying diagrams, the engine data being as follows: Diameter of cylinder, 14 inches; length of stroke, 34 inches; revolutions per minute, 98. The spring used in the indicator represented 60 pounds per in. —J. N.

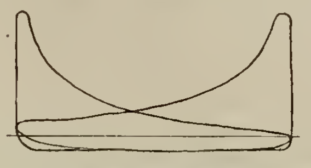


FIG. 1. MEAN PRESSURE 34.75. IND. HORSE POWER 90.

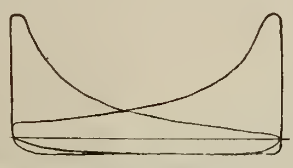


FIG. 2. MEAN PRESSURE 38.14. IND. HORSE POWER 98.78.

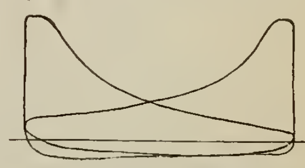


FIG. 3. MEAN PRESSURE 44.625. IND. HORSE POWER 115.58.

The illustrations with the accompanying underlines give the information required. It may, however, be stated that the "crank" and "cover" ends of each figure should have been given, as by so doing a more effective comparison of the work being performed in the cylinder per stroke is possible. In Figs. 1 and 2 a considerable difference is to be noted in the mean pressures registered at left and right hand ends, these being respectively, for Fig. 1, 31.5 and 38 pounds, and in Fig. 2, 35.40 and 40.88 pounds. In Fig. 3, the respective pressures are 44.25 and 45 pounds respectively.

* * *

Fan Horse Power.—Please inform me through your Question and Answer Department how to arrive at the horse power necessary to drive a fan?—S.M.

The power required to run a centrifugal fan for a given duty may be found by the following formula:—

$$\text{H.P.} = \frac{\text{C} \times \text{wg. ins.} \times 5.2 \times 100}{33000 \times \text{E}}, \text{ where}$$

C=volume of air in cub. ft. per minute; wg. ins. = resistance in inches of water, and E = efficiency. The latter is a very variable quantity and depends upon the make of fan, also as to whether a suitable size of fan is used. If a suitable fan is chosen, E will be about 40 per cent. with a straight bladed fan, and about 50 per cent. with a curved forward bladed fan. A straight bladed fan usually has six or eight blades, and a curved-forward bladed fan from sixteen upwards. When air is passed through ducts (steel, wood or brick), a resistance is set up which varies as the square of the velocity; in other words, if the velocity is doubled the resistance will be quardrupled.

When operating in the open, not against resistance, the mechanical efficiency of a propeller fan is from 30 to 40 per cent., and the power required may be obtained from the following formula:—

$$\text{H. P.} = \frac{\text{WV}^2 \times 100}{2\text{g} \times 33000 \times \text{E}}, \text{ where W} =$$

weight in pounds of air moved per minute; $\text{V} = \frac{\text{cub. ft. air per sec.}}{\text{fan area in ft.}}$; g = 32.16, and E = fan efficiency (say 35 per cent.). The ducts for propeller fans, when required, should always equal the area of the fan at the latter, and care should be given the design so that the air velocity is as low as practicable. Over 700 ft. per minute velocity will result in a considerable reduction of fan output. If silent running is desired, the peripheral speed of a propeller fan should not exceed 4000 ft. per minute, and is safe at about 3000 ft. per minute. The centrifugal fan is more efficient against resistance than the propeller fan, size for size (comparing the outlet of the former with diam. of the latter). It costs probably four or five times as much for equal duties, but with small ducts especially, and if these be of any length, its use is essential.

Oil Fuel Installation.—We purpose changing from coal to crude oil fuel in our Scotch marine type, two-furnace boiler, the working steam pressure of which is 165 pounds per sq. inch. What size pump do we require to feed the oil to the boiler? Is the oil pumped direct to the furnace or by way of a tank, and about what size pipe will be required? How many burners are necessary for each furnace, also what arrangements fall to be made to keep fumes and gas from leaking through furnace doors due to back draught? How many gallons of crude oil are equivalent in heating value to a ton of coal?—G. L. M.

It may be stated at the outset that the data covering your boiler installation is largely incomplete. On the other hand the detail arrangement and application of an oil-burning equipment in connection with same should be sought from firms who specialize in that direction. The best we can do under such circumstances is to treat the subject of oil firing of steam boilers in a general way, leaving the detail for suggestion as to fitness for your particular installation to firms concerned. Oil as compared with coal has its advantages as well as disadvantages, and both should be considered in a projected change-over. Under both these headings, Marks' Engineers' Book refers to oil fuel as follows:

Advantages—The handling cost is low, oil being fed by simple mechanical means.

Labor saving is made possible throughout the plant by the elimination of stokers, coal passers, ash handlers, etc.

For equal heat value, oil occupies very much less space than coal, and the storage space can be at a distance from the boiler without detriment.

Combustion with oil is more perfect than with coal, the excess air being more readily reduced to a minimum. There is no ash, which in the burning of coal usually contains considerable combustible matter. The furnace temperature may be kept practically constant and smoke may be eliminated with the resulting increased cleanliness of heating surfaces. The more perfect combustion results in higher efficiencies than are possible with coal.

The intensity of the fire can be almost instantaneously regulated to meet local fluctuations.

There is no loss in calorific value, or difficulties arising from disintegration and slow oxidation where oil is stored such as are possible in coal storage.

Oil is cleanly and free from dust, with a consequent saving in wear on machinery.

DISADVANTAGES—The disadvantages of oil comprise necessity that it have a high flash point to minimize the danger of explosions. Ordinances may also be in effect relative to docation and isolation of storage tanks, and that make oil fuel application prohibitive. Unless boilers and furnaces are specially adapted for oil fuel, the upkeep cost will be higher than if coal were used.

The best results are secured with a furnace in which the oil is introduced in the direction in which it increases in volume, insuring free expansion and a thorough mixture of the oil with the air, and complete combustion of the gases before they come into contact with the heating surfaces. A flat flame burner in such a case gives best results. Burners should be located so that their individual flames do not impinge to any extent on the side walls or lanes of smoke. Steam spray atomizing burners—inside or outside mixing type, are almost universally employed. Heating the oil is advantageous in causing it to be atomized more readily and in securing economical combustion. Such heating should be done as close to the burners as is possible. By-passes should be placed between the oil and steam ducts of a burner for blowing the oil piping and burner clear of deposits. Strainers should be installed in duplicate in the oil lines for removing the silt carried by the oil. Mechanical atomizing burners are usually of round flame type, the oil being fed to the burner under pressure varying with the rates at which it is to burn, and being given a rotary motion before issuing from the burner nozzle. Relative values of coal and oil fuel may be gauged approximately from the following calculated data:—With net boiler efficiency of 71 per cent. and with evaporations of 5 and 12 pounds of water, from and at 212 degs. F. per pound of coal, the respective oil consumpts are .369 and .886 pounds. With net boiler efficiency of 81 per cent. and evaporations as above, the respective oil consumpts are .324 and .777 pounds.

*

Fire-Brick Setting.—One of the difficulties to be encountered where ordinary bricklayers are engaged on the fine work is that of jointing and facing the brickwork of furnaces, as you cannot make them see that the thinnest possible fire clay joint and perfectly smooth face to the work is necessary to secure durability. Fire-clay should be sifted through a ¼-inch square meshed sieve into water, and it should soak at least 12 hours before using. Bricks should be well wetted before use, and, in laying these, the clay should be decidedly softer than mortar, while the bricks should be well beaten down. After each course is laid it should be thoroughly grouted down with fireclay, so that the whole forms a solid mass, and backings of ordinary brick should be treated in the same way. A well-built furnace keeps in good condition, while one with wide joints will fail in a short time.

Steam Power Plant Auxiliaries

STEAM TRAPS.—IV.

THE various types of traps already described in these articles have all been characterized by a feature which in the case of float-operated valves may ultimately give trouble if the construction be not of the highest class. This feature is the presence of steam pressure in the space occupied by the valve gear, etc., and in the case of float-operated valves working under high pressure, the possibilities of trouble due to leaky or collapsed floats are naturally greater than with bucket or expansion traps. In addition to this, the necessity of making the trap body strong enough to stand high pressures calls for increased weight and reinforcement when box-shaped bodies are used.

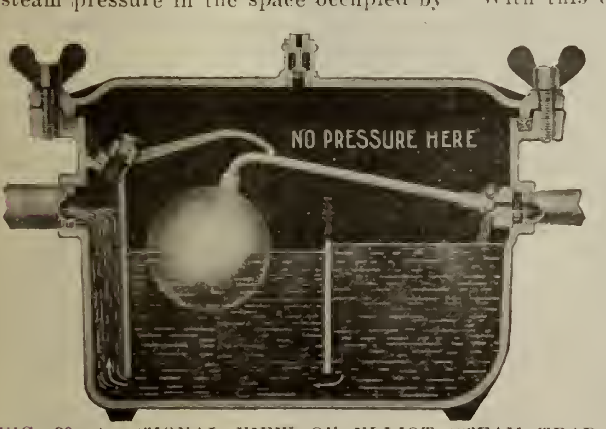


FIG. 20. SECTIONAL VIEW OF ELLIOT STEAM TRAP SHOWING VAPOR VENT CONTROLLED BY FLOAT.

Elliott Steam Trap

This trap belongs to that group of float-operated traps in which the float and operating mechanism are on the atmospheric side of the shut-off valve and are not subject to full steam pressure, the only pressure existing being that necessary to elevate the water from the level in the trap to the outlet, and as this distance is only a few inches, the pressure required may be disregarded. A sectional view of the trap in operation is given in Fig. 20, and an outside view of a Class A trap is shown in Fig. 21, this being suited for pressures up to 125 lbs. per sq. in. and adapted for automatically draining water of condensation from steam pipes, steam coils, radiators and for general purposes.

The water in the line leading to the trap has a temperature of within a few degrees of the temperature of the steam at the same pressure, and as the water enters the trap where there is practically no pressure, its temperature immediately drops to about 212 degs. F., as that is the highest temperature water will carry at atmospheric pressure. With this drop in temperature, the water parts with what may be termed its surplus heat in the form of a vapor arising from re-evaporation of a portion of the water. The slight pressure in the trap is caused by this vapor, and it is this pressure which forces the water up the ejectment pipe and through the outlet of the trap. It is obvious that the amount of vapor formed from re-evaporation of the water will increase in proportion to the amount of water entering the trap, and the excess vapor is permitted to escape into the discharge outlet through a vent opening in the top of the ejectment pipe, this opening being automatically increased or decreased in proportion to the amount of water entering.

Referring to Fig. 20, let it be assumed that the trap is in service with the inlet valve party open and the water level as shown. The slight pressure in the trap forces the water up the ejectment pipe and through the outlet, as indicated by the arrows. As long as the water enters at a uniform rate, the water level will remain at the same point, and the excess vapor will escape through the vent openings.

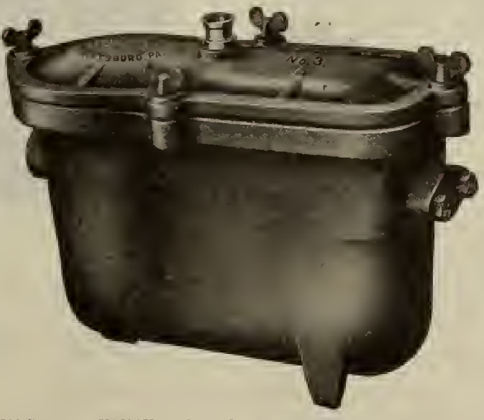


FIG. 21. EXTERIOR OF ELLIOT CLASS "A" STEAM TRAP.

The inlet valve never actually closes, for a groove is cut in it to permit the water to trickle into the trap and begin to raise the float. Steam will not escape through this groove as there is always enough condensation in saturated steam pipe lines to insure the valve being sealed with at least a small amount of water. The valve is of the ball type, and both it and the valve-seat bushing are made of a special metal which experiment has demonstrated as being best able to resist the cutting action of hot water.

No live steam can escape through the trap, because, should it happen that all the condensed water be drained from the line and steam allowed to enter the trap, enough pressure would be created to immediately lower the water level and close the valve, which would remain closed until fresh condensation collected in the line and passed slowly through the valve to add to the water in the trap.

Three classes of this trap are made "A" for pressure under 125 lbs., "B" for pressures over 125 lbs., and "C," which is of the elevating type. Class "B" traps can be fitted with a blow-through attachment for draining engine jackets, or any desired heating system. These traps are made by the Elliott Company, Pittsburgh.

Anderson Steam Traps

In the model D trap of this type, every effort of the makers has been directed toward producing a trap which will give satisfactory service when used in connection with any apparatus using steam at pressures varying from 250 lbs. per sq. in. to gravity, and also where there is condensation in air lines. This trap, illustrated in Figs. 22 and 23, works continuously and automatically; the valve and seat are sealed with at least three inches of water at all times, thus eliminating the possibility of live steam escaping with the condensation.

One of the prominent features is the ease with which the valve and seat can be changed to accommodate the varying pressures at which it may be desired to operate the trap. Should the trap in use be fitted to work from 150 lbs, and under, this can be accomplished by inserting a valve and seat suitable for the desired pressure, an operation which can be performed in a few minutes and without removing the trap from the line. The body of the trap is of suitable shape to withstand pressure stresses, and has a removable perforated metal strainer arranged at the inlet which protects the valve and seat against scale packing and other sediment. The gauge glass fittings as well as air and drain cocks are also mounted on the body.

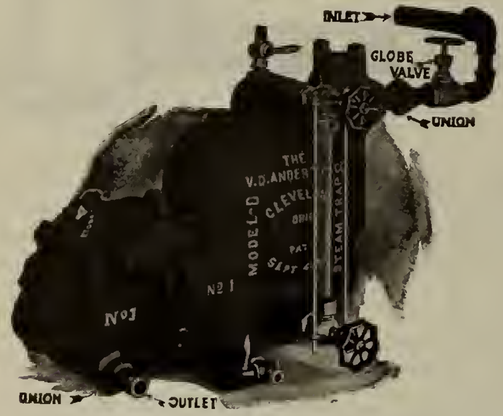


FIG. 22. ANDERSON MODEL "D" TRAP PIPED FOR ORDINARY SERVICE.

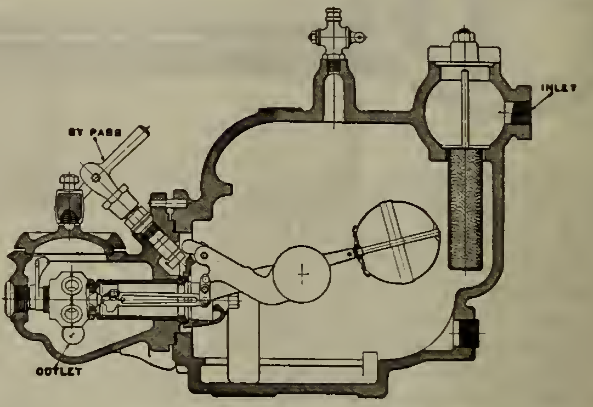


FIG. 23. SHOWING STRAINER, VALVE AND BY-PASS OF ANDERSON TRAP.

The valve and its operating mechanism are mounted on a flanged globular casting with by-pass operating handle and removable cover through which the valve can be reached. All gaskets are set into counterbored recesses and all bolt strains are brought to bear directly over the packing joints which eliminates any possibility of their blowing out.

The trap as shown in Fig. 22 is piped up correctly for all ordinary purposes where condensation is discharged on a level with or below the outlet of the trap, the drain, or discharge line, being connected to the side of the trap head which is most convenient. Two standard valve openings are obtainable, viz., from 150 lbs. down to 30 lbs., and from 30 lbs. down. For pressures below 10 lbs. and over 150 lbs., special openings are furnished.

Anderson Junior Steam Trap

This apparatus is made especially for use on sterilizers, paper dryers, radiators, or any place where a steam trap of small capacity is required. It has no by-pass or gauge glass and is arranged as shown in Fig. 24, for use on ordinary steam lines. The interior construction is shown in Fig. 25, the mechanism being arranged on the unit principle, as in the larger model D trap, both of these traps being the product of the V. D. Anderson Co., Cleveland, O.

FIG. 24. ANDERSON JUNIOR STEAM TRAP.

Marck Therm Steam Trap

The apparatus illustrated in Fig. 26 is an example of the thermostatic type, which depends on the expansion of a solid liquid, or gaseous body for a means of operating the valve. The Marck Therm steam trap is designed for use on the discharge end of low-pressure steam using apparatus, and may be described as an automatic valve which is always open at temperatures below 212 degs. F., and always closed at higher temperatures. It is particularly adapted for draining radiators and heating coils, whistles, sirens, and other steam apparatus on vessels, and also such items as steam cooking equipment, etc., where low pressure steam is used.

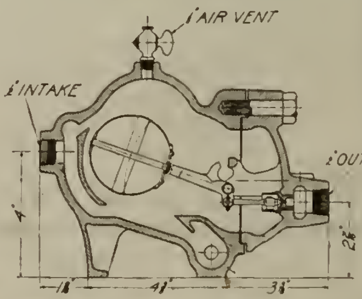


FIG. 25. SECTIONAL VIEW OF FIG. 24.

The interior of the trap is shown in Fig. 26, from which the simplicity of this type of trap is apparent. The tubular crescent-shaped member A, is filled with a liquid which becomes a gas at 212 degs. F., and is securely sealed against leakage. Valve B and stem C, are guided and supported by block D, while spring E holds tube A in position against adjusting screw F, thereby preventing A from expanding in any other direction than that of valve seat B. This spring, however, has no effect on the action of tube A. An adjusting screw F enables tube A to be moved in either direction to insure the proper seating of the valve.

As long as the temperature surrounding the tube remains below 212 degs., the liquid in the tube remains inert, and the valve is open as set. When steam is first turned on, the trap being open, all air and water of condensation and dirt are blown through until, when steam attempts to pass, the temperature rises above 212 degs. causing the tube to expand and seat the valve. The trap now remains closed until the temperature drops below 212 degs., when the tube contracts and opens the valve to allow passage of air, water, etc., until steam again raises the temperature. E. F. Houghton & Co., Philadelphia, are the makers of this trap.

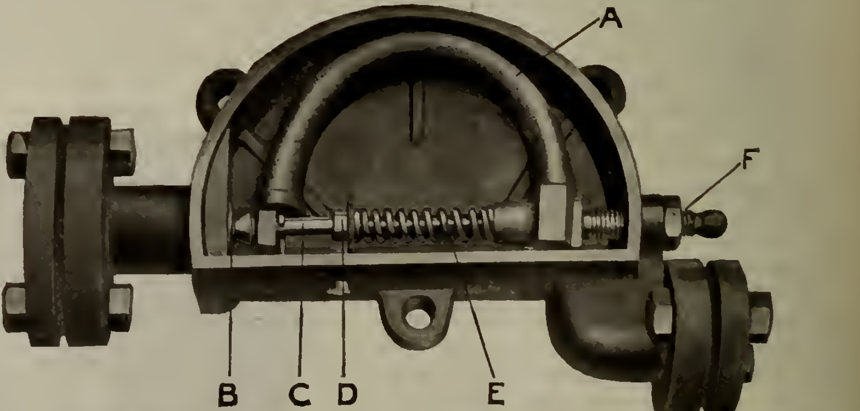
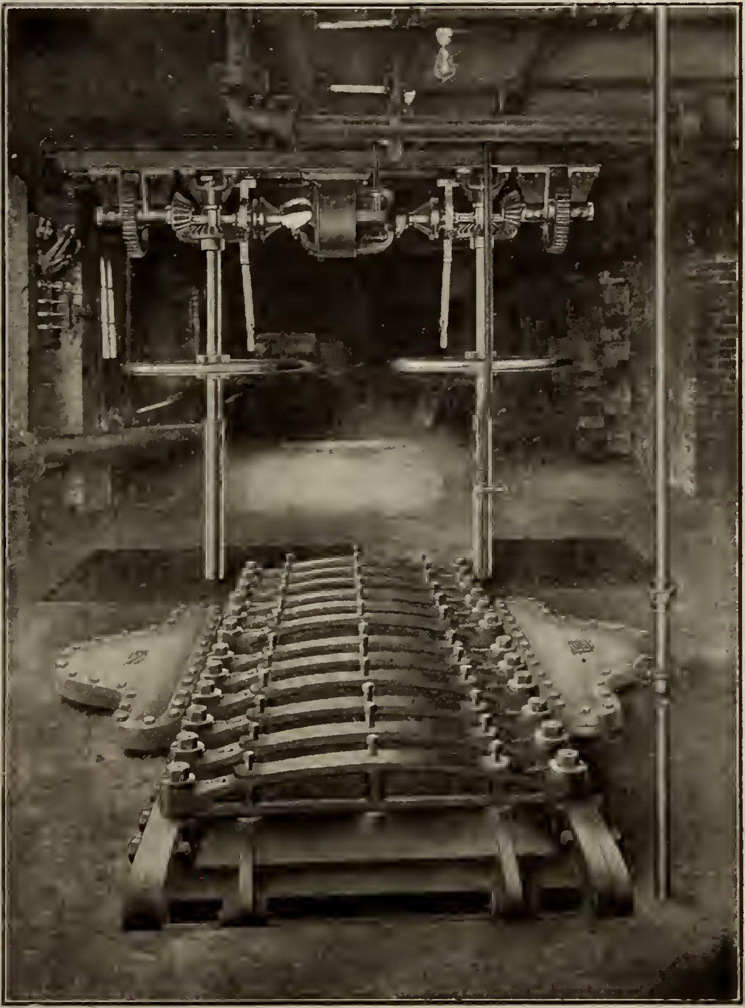


FIG. 26. SHOWING THERMOSTATIC TUBE AND VALVE ARRANGEMENT OF MARCK THERM. TRAP.

THE SIZE IS 42 INCHES



Elliott Motor Operated Twin Strainers

THE HISTORY

Something over two years ago the Toledo Railways and Light Company purchased their first Elliott Twin Strainer to protect their condenser equipment. The satisfaction this Strainer has given is best illustrated by their order for a still larger size (42-in.) for a similiar purpose which is shown installed as above.

This strictly modern plant demanded the most up-to-date equipment. It will be noted that the Strainer valves are motor operated from overhead, where the motor will not be affected during flood stages.

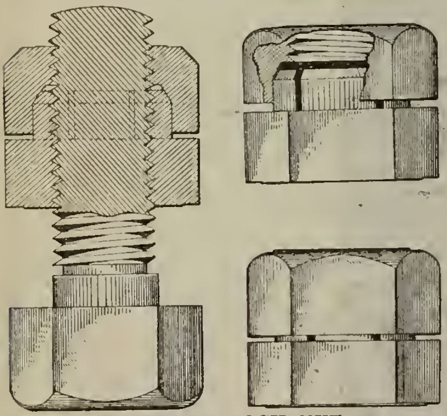
Elliott Twin Strainers are supplied for both motor and manual operation in all sizes from 1 in. to 48 in. inclusive. The basket equipment is varied to meet conditions. Complete information is contained in Bulletin "A." Shall we send you a copy ?

ELLIOTT COMPANY
6902 SUSQUEHANNA STREET
PITTSBURGH, PENNA.
ranch offices in all principal cities

Progress in New Equipment

NEW TYPE LOCK NUT

A LOCK nut in which the dead and not the moving member is locked has been developed by the Western Screw and Lock Nut Co., San Francisco, Cal. With this nut no washers are required and the nut can be locked at any point on the bolt, an arrangement which makes it possible to take care of oscillating or pulsating movements. The bolt and nut can be used over and over several times, it is claimed, without damaging the threads. It is possible also to fit a United States standard nut tightly on a bolt having a V-thread, and it is also possible to make a nut tight on a loose fit bolt.


NEW TYPE LOCK NUT

The lock nut consists of two members. The lower, which is the nut proper, is similar in form to a regular hexagon nut and has four flexible finger members projecting from its upper surface. When the upper or locking member is screwed down, these fingers are compressed and the nut is frozen, as it were, to the bolt. The locking action is secured by turning the locking member firmly. When locked in place this member is counted on to help carry the load. One of the features of the lower member is a number of threads which provide capacity to carry the load. The nut is released with an ordinary wrench, and when the locking member is released it will of course move as one of the ordinary type.

A recent test of the holding power of one of these nuts was made by bolting two pieces of ¾ x 1½-in. bar steel together with a ¾-in. lock nut and one of the ordinary type placed 6 in. apart. The steel bars were suspended on heavy springs and an air hammer delivered 500 blows per minute with a force of 25 lbs. midway between the two bolts. It is stated that the ordinary nut was jarred off in a short time, thus leaving the strain on the other bolt. After 9 hours of continuous jarring at this rate the lock nut was still gripping firmly.

◆

NOVEL STEAM TRAP.

THE steam trap or drain cock illustrated, is one of those devices that seem to defy the laws of physics. In construction it is extremely simple and in operation quite effective, but the true explanation of its functions is difficult. Fig. 1 shows general views of the trap, and Fig. 2 is a sectional elevation. It comprises a body or outer casing A, an automatic combined discharge and piston valve B, an adjustable screw valve C, a blow-through air valve D, and a cover E to give access to the piston valve. The latter is a loose fit in the body, and allows steam to pass to its upper surface and through the valve C. The makers are James Baldwin & Co., Keighley, England, who claim that the action of the apparatus is due to dynamic impulses, like "water hammer." The sectional illustration shows the trap in its normal condition, condensation water having accumulated in the inlet side of the body and below the piston valve. The following explanation of the action of the trap is given by the makers:—

FIG. 1. PLAN AND ELEVATION OF TRAP.

The water at A is drawn by the flow into the pocket under piston B until full. The next following water then traps a certain quantity of steam between the top of the water in the pocket and the underside of the piston B, compressing and increasing the pressure of the steam trapped, thereby lifting the piston, opening the outlet valve, and discharging the water. The action is intermittent, the water being ejected in pulsations varying between 40 and 60 per minute, according to the setting of the regulator valve C. Upon this device the action of the trap depends.

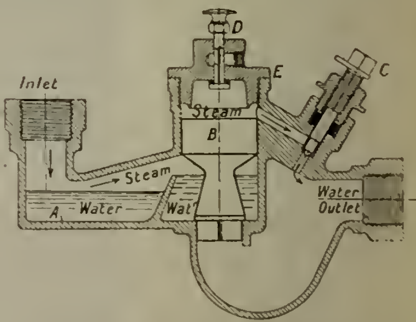


FIG. 2. SECTIONAL ELEVATION OF TRAP.

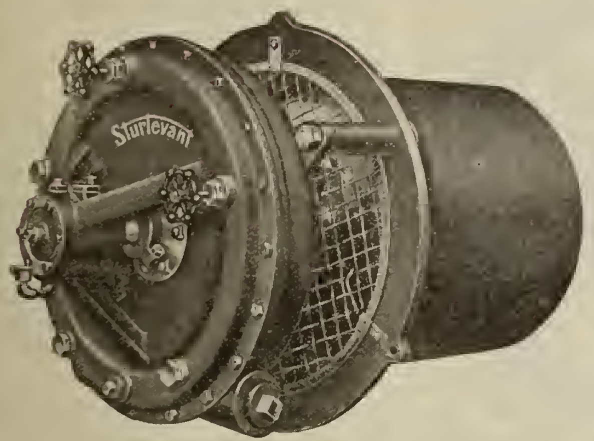
To start the trap the regulating valve is opened full. The steam is then turned on to the trap, through which it is discharged freely. Then the regulating valve is gradually and partially closed. Condensation takes place, and the temperature falls to normal, after which the trap can be finally adjusted to discharge either water mixed slightly with live steam or water of high temperature, i.e., not less than 205 deg. or 206 deg. Fah. We understand that the relative areas of the piston and discharge valves are not of essential consequence, the makers having constructed for experimental purposes traps of this kind, in which the piston and valve were of similar diameters. In this case it was only necessary to increase the opening of the regulator C to secure the extra energy necessary to open the discharge valve.

◆

PISTON THROTTLE VALVE

THE throttle valve here featured has been specially designed by Lancaster & Tonge, Pendleton, Manchester, England, for controlling the admission of steam

The Man Below Cannot Do It All



Do not blame the engineer and the fireman if you cannot get all the steam you want—if the pressure goes down—if steam cannot be gotten up in a hurry. It is not all their fault. Your boilers are overloaded, and to get the extra steam you should install a

Sturtevant
(REG. CAN. PAT. OFF.)

Turbo-Undergrate Blower

It will give you sufficient draft to get over peak load. Granted that you have decided upon some blower, why not a Sturtevant? Mechanically it is superior to any other.
Take the bearings for instance. There are no ball bearings to rust, crack or give trouble, but instead there are generous bronze journals with oil-ring lubrication. The reservoirs are of ample capacity and will hold an oil supply that will last for several weeks.

Bulletin 214-U tells what the Sturtevant Blower will do. A copy is awaiting you.

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B. F. Sturtevant Company of Canada, Limited
GALT, ONTARIO, CANADA
MONTREAL TORONTO WINNIPEG VANCOUVER
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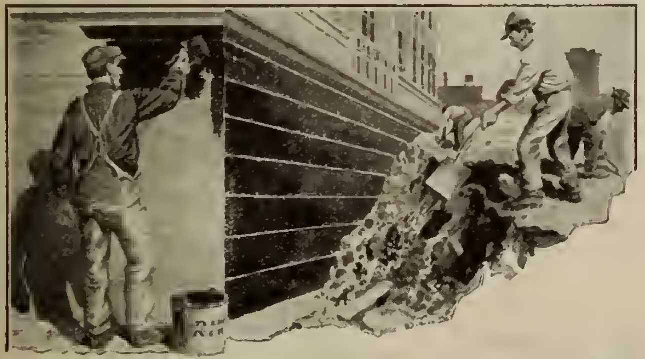


"This cellar will be dry"

THERE will be no trouble here from dampness getting into this cellar wall. I am applying a coating that will keep it as tight as a drum. It is the best material I know of, and it is called—

R.I.W. REMEMBER IT'S WATERPROOF
REG. U.S. PAT. OFF.
MARINE CEMENT

R. I. W. Marine Cement is applied from footings to grade level of brick, stone and concrete foundation walls. Very successfully used on the McKinley Memorial Monument at Canton, Ohio.

When wood flooring is to be laid over cinder concrete the sleepers and under side of the flooring should be coated with R. I. W. Trimbak, followed by R. I. W. Marine Cement over the concrete and sleepers before the flooring is laid.

Applied cold with a brush or swab.

Write for a copy of the Red Book from Dept. 59

R. I. W. DAMP-RESISTING PAINT CO.
TOCH BROTHERS
Gerrard St. and Carlaw Ave.
TORONTO, ONTARIO, CANADA

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914, With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

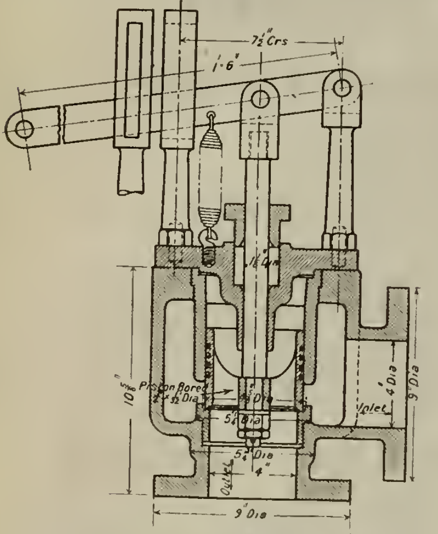
All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID.
Minister of Public Works and Highways.

W. A. RIDDELL, M.A. Ph.D.,
Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

to winding, hauling, and reversing rolling mill engines, with the minimum of exertion on the part of the attendant. As will be seen from the sectional illustration, the valve is of the piston type with a single seating, steam tightness being effected by means of four ordinary piston rings of rectangular section, while it is balanced sufficiently for all practical purposes. In order to give the finest possible regulation of the steam and very gradual admission at first, the seating is formed with an annular collar, the inner surface of which is made slightly tapered, so that the passage for the steam is somewhat constricted until the valve is lifted clear. When used in connection with colliery winding engines, the valve lever is fitted with a weight or spring to cause the valve to close sharply, in case the overwinding gear comes into action.



SECTIONAL ELEVATION OF PISTON THROTTLE VALVE.

* * *

STEAM TURBINE DRIVEN INDUCED DRAFT FANS

THE high degree of perfection now obtainable in high-speed reduction gears is resulting in the adoption of steam turbines as the motive power for such items of boiler house equipment as induced draft fans. The simplicity and reliability of steam turbines renders them very suitable for boiler-room service, but until high-speed gears were commercially available, their relatively high speed had prevented the extensive use of steam turbines for the fans referred to, as such fans on account of the large volumes handled are usually of relatively slow speed.

Two recent installations of turbine-driven fans are shown in Figs. 1 and 2, the turbines being built by the Terry Steam Turbine Co., Hartford, Conn., and the fans by the Green Fuel Economiser Co., Beacon, N.Y. These fans are driven through herring-bone reduction gears, the unit in Fig. 2 having a ratio of 6.78 to 1, with a maximum pinion speed of 3,630 revs. per min. Fans for this class of work require from 25 to 50 horse-power, and give a draft of from 2 in. to 5 in.

On account of the warm location the bearings of both fan and turbine are water cooled. The turbines are of the Terry helical flow type in which the steam is passed repeatedly through a single row of moving buckets, this design permitting the use of a wheel made from a single steel forging with buckets milled from the solid.

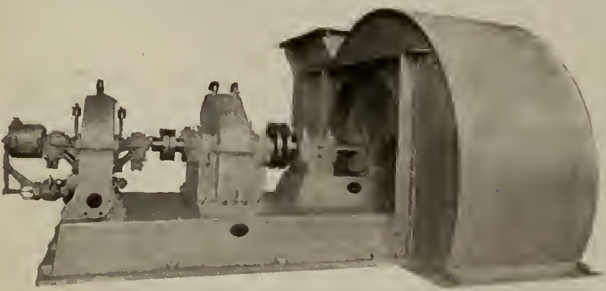


FIG. 1. STEAM TURBINE-DRIVEN INDUCED DRAFT FAN WITH GEAR REDUCTION.

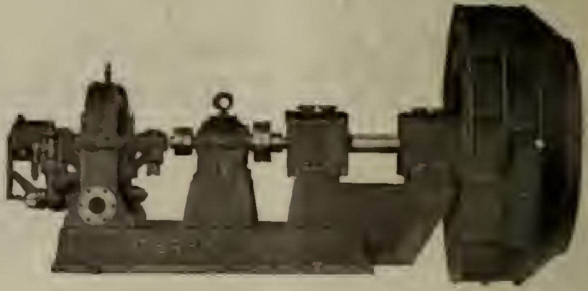


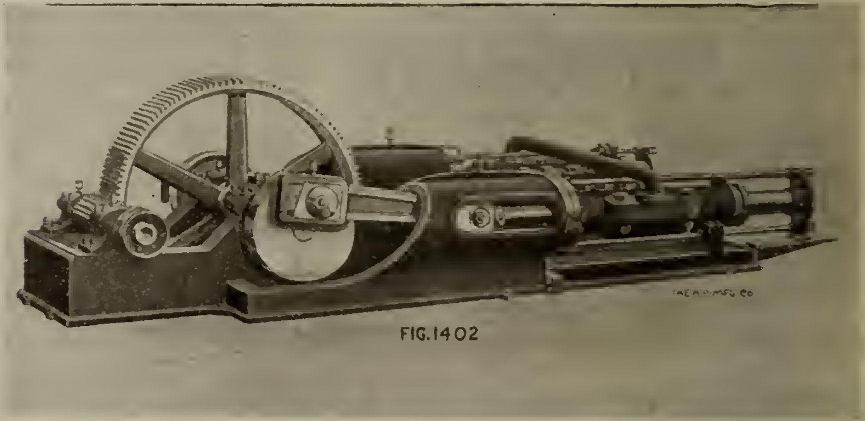
FIG. 2. FAN WITH CASING REMOVED, SHOWING CONSTRUCTION OF IMPELLER.

* * *

MOTOR DRIVEN FOUR PLUNGER HORIZONTAL HYDRAULIC PUMP

THE hydraulic pump illustrated by the accompanying photograph is a recent addition to the extensive line of high pressure hydraulic pumps built by The Hydraulic Press Mfg. Co., Mount Gilead, Ohio. It is of the horizontal, four-plunger type and designed to fill the requirements for a simple, heavy duty hydraulic pump for supplying a large volume of water or other fluid against a high pressure.

It is designed so that it may be equipped with sixteen different sizes of plungers ranging from 1⅜ inches to 5 inches in diameter, advancing by quarter inches. The water cylinders are made of forged steel for the highest pressures. For the medium pressures, 1500 to 2900 lbs. per sq. in. inclusive, cast steel is used, and for the lowest pressures the cylinders are semi-steel. The pressures range from 9500 to 700 lbs. per sq. in., and the water capacity from 24 to 326 gals. per min. All sizes have bronze valve seats and bronze or nickel steel valves.



MOTOR-DRIVEN HORIZONTAL HIGH PRESSURE HYDRAULIC PUMP.

The pump illustrated is built for motor drive, requires 150 horse power to operate, and is equipped with a flexible shaft coupling for motor connection. Any motor having a speed of from 450 revs. per min. to 750 revs. per min. may be used. The speed of the shaft is 60 revs. per min. The stroke of the plungers is 16 inches, the two cracks being set at 90 degs., so that a more uniform flow of fluid may be obtained than with a triplex pump.

At all points where the strain and wear is most severe, the parts such as main bearings, connecting rod ends, cross-head guides, valves and valve seats, are of easy access for adjustment and replacement. The frame or pump bed consists of two heavy castings securely bolted together, the cross-head guides

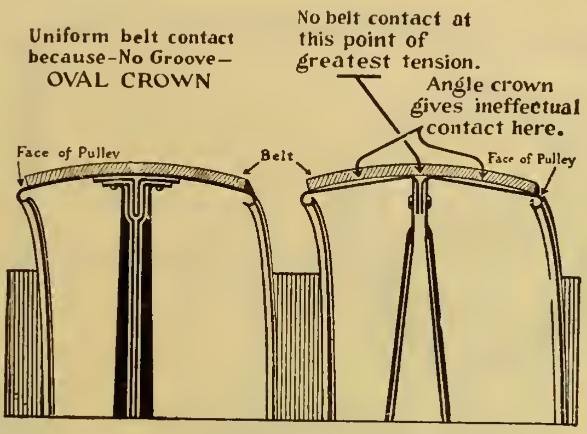
Oneida Steel Split Pulleys

If you are not using this "closest approach to pulley perfection," we have in store for you an additional means of cutting down expense and improving your plant.

For your own best interest—for the sake of your factory overhead—look into this matter of steel pulleys.

And when investigating, you might as well start in at the top, with the steel pulley that has actively demonstrated its positive superiority over all other steel pulleys—the pulley of such construction that not only makes practicable its use for ordinary line shaft work, but is also successfully built, without a change of design, in sizes capable of transmitting 750 H.P.—and more if necessary.

Let us fill your next pulley order with an Oneida. For your convenience we keep on hand a "perpetual stock" of all sizes—your urgent needs can be filled at once.


Uniform belt contact because–No Groove–
OVAL CROWN
No belt contact at this point of greatest tension.
Angle crown gives ineffectual contact here.
Face of Pulley
Belt
Face of Pulley

This advantage is tangible.

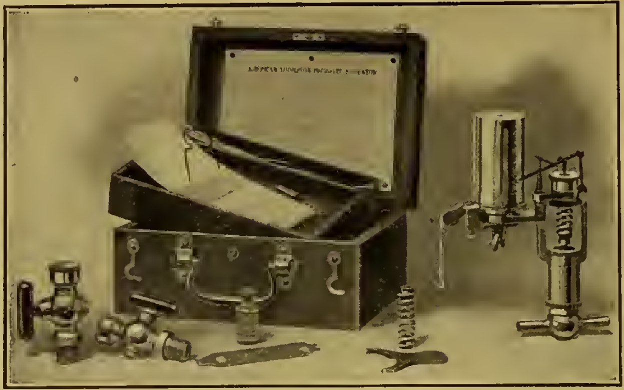
Unless a pulley has a face insuring efficient belt contact, it is not an economical pulley to use.

The Oneida is a one-piece, perfect oval crown, with no groove running through the centre. All of the face surface is efficient surface; the belt uniformly hugs the crown, producing the greatest amount of belt adhesion with the least belt tension. Operating conditions being the same, the Oneida will, for this reason, transmit from 5 to 20 per cent. more power than a pulley having an angle crown that requires greater belt tension to force efficient belt contact, and that has a centre groove which subtracts belt area from the most vital point of the face—the centre.

The Canadian Fairbanks-Morse Co., Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Windsor, Winnipeg,
Saskatoon, Calgary, Vancouver, Victoria

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS



NEW YEAR RESOLUTIONS WILL SOON BE MADE

Don't consider yours complete until you have ordered your AMERICAN-THOMPSON IMPROVED INDICATOR for delivery, so that you can receive its benefit every day, beginning January 1, 1917

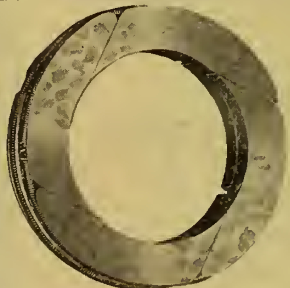
OUR EASY PAYMENT PLAN will make this possible.

Write for details.

Sole Canadian Agents: The CANADIAN FAIRBANKS-MORSE CO., LTD., Montreal, Toronto, Winnipeg.

American Steam Gauge & Valve Manufacturing Co.

New York Chicago BOSTON Atlanta Pittsburgh



Packings that are Different

Cut at a **tangent** to the piston rod and joints on diametrically opposed sides of the piston are parallel. This arrangement of the joints of the ring allows the parts to adjust themselves to every slight inequality of wear in the diameter of the rod as they float freely both friction and wear upon the rod are practically negligible.

OTHER ADVANTAGES

No clearance for wear adjustment need be left between the ends, and sudden failure with this type of packing is impossible.

Cast iron or bronze used for rings is made to a special formula based upon many years of experience. **Once known, always used.**

The Martell Packing Company, Elyria, Ohio

Canadian Agents: THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED
Toronto, Montreal, Winnipeg, Calgary, Vancouver, St. John

MARTELL PACKINGS
MEAN
MORE POWER

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.
Philadelphia, Pa.

Canadian Agents:

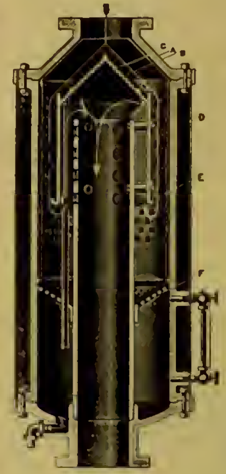
The Canadian Fairbanks-Morse Co., Limited
St. John, Quebec, Montreal, Ottawa, Toronto
Hamilton, Winnipeg,
Saskatoon, Calgary,
Vancouver, Victoria

CFM

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.



I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY
820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:
Canadian Fairbanks-Morse Co., Limited
St. John, Montreal,
Quebec, Ottawa,
Toronto, Hamilton,
Winnipeg, Saskatoon,
Vancouver, Victoria.

CFM

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Braided for Rods

IF YOU ARE INTERESTED

In the economy of long service even under hard conditions—try

TRADE MARK

"PALMETTO" PACKING

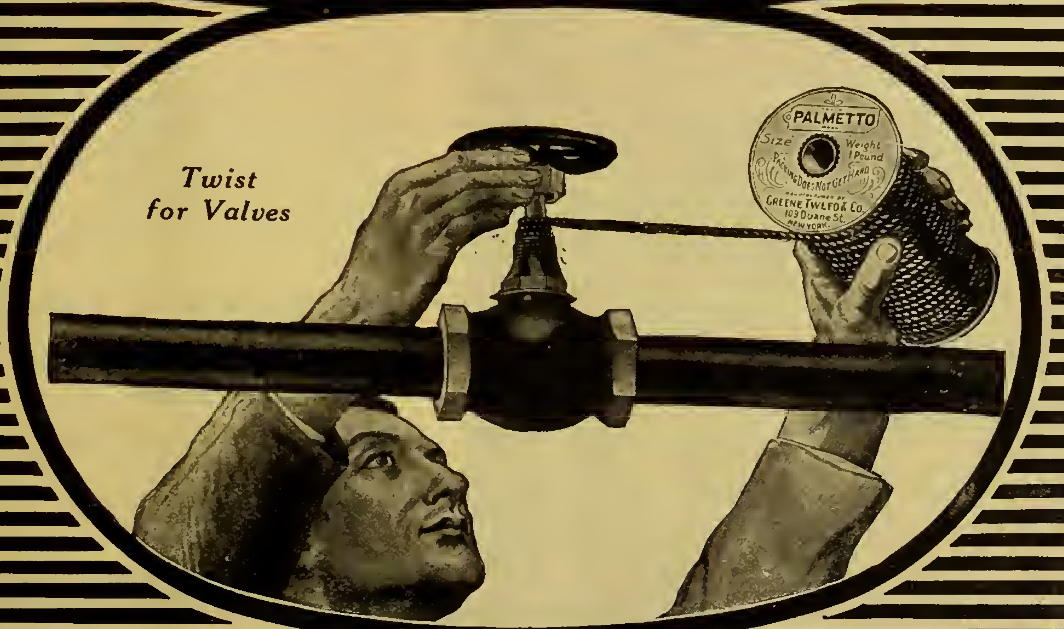
Its quality never varies because it is made of first grade materials so that under high pressure superheated steam and compressed air pressures it has no equal.

Let us send you free working sample as proof.

GREENE, TWEED & CO., *Sole Manufacturers* **109 Duane St., New York**

Representatives in Canada: THE CANADIAN FAIRBANKS-MORSE COMPANY, Limited.
St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.

Twist for Valves



G. J. NICHOLSON, President
C. W. KENDLE, Sec'y & Treas.
WE ARE NOT RESPONSIBLE FOR GOODS AFTER DELIVERY TO TRANSPORTATION COMPANY
NICHOLSON-KENDLE Furniture Co.
MANUFACTURERS
[illegible]
COR SECOND AVE AND TWENTIETH ST
Huntington, W. Va.

Feb. 11, 1916.

The Graton & Knight Mfg. Co.,
Philadelphia, Pa.,
Gentlemen:-

You will undoubtedly be interested to learn of the service we have derived from the 24" 3-ply Heart Belt we installed January 7th, 1913. This belt drives our entire factory. it has not been taken up since it was placed in operation, and is still giving perfect satisfaction.

Since installing this 24" Heart Belt, we have found it to our advantage to standardize on your Heart Belting throughout our plant. This will indicate more forcibly than words the satisfactory service we have derived from the use of your belting.

Yours very truly,
NICHOLSON-KENDLE FURN. CO.
C. W. Kendle

CWK/EC

> "There's no use arguin' agin' a success."
> —*Josh Billings.*

—This bit of homely philosophy explains why the Nicholson-Kendle Furniture Company, and others, standardize on Heart Belting.

—Manufacturers to-day are considering as never before efficiency and economy as applied to plant operation, and a belting must be "a success," must make good before that particular belting is adopted as standard equipment.

—In all industries wherever STRICTLY FIRST QUALITY HEAVY belting is required, Heart Brand is the selection because it is made from the choicest oak tanned leather, tanned in our own tannery slowly, uniformly, and expressly for belting purposes—because it is made carefully, intelligently and honestly—because it is graded to a certain specified standard of quality—because it is "a success."

—You, too, may place full dependence upon Heart Belting, for "There's no use arguin' agin' a success."

THE GRATON & KNIGHT MFG. COMPANY

Manufacturers of the Famous Spartan Belting

WORCESTER, MASS,, U.S.A.

Representatives in Canada: The Canadian Fairbanks-Morse Co., Limited, St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver

"Consult our Engineering Department in connection with your Transmission Problems."

and main bearing containers being machined in the frame. This insures perfect alignment and gives the most rigid construction. The pump occupies a floor space 18 feet, 8 inches in length by 6 feet, 10 inches in width. While the illustration shows the pump equipped with a spur gear and pinion, it may also be equipped with a herringbone gear and pinion.

Trade Gossip

Grand Forks, B.C.—The Town Council propose extending the municipal power plant.

St. Alexis, Que. — The Saguenay Light & Power Co., are building a power house here.

Hespeler, Ont.—The Town Council propose making extensions to the waterworks system.

Winnipeg, Man.—The Manitoba Pulp & Paper Co., propose building a power plant at Grand Rapids.

Hawkesbury, Ont. — The Riordon Paper Co., propose extending their boiler and pumping plant here.

Toronto, Ont.—The Taber Laundry Works will build an addition to their boiler room on Bathurst Street.

The Polson Iron Works, Toronto, have been awarded a contract for boilers by the Lincoln Paper Mills Merritton, Ont.

St. John, N.B.—The City Council will shortly call for tenders on the supply of about 3,000 feet of 20-in. cast iron pipe.

Lethbridge, Alta.—A by-law was carried to authorize a payment of $17,000 for extensions to the electric light system.

Cornwall, Ont.—The Town Council propose building an extension to the pumping station and installing centrifugal pumps.

Canadian Allis-Chalmers Ltd., Toronto, have been awarded a contract for pumping equipment for the town of St. Marys, Ont.

Toronto, Ont—A contract has been awarded by the Board of Control to Drummond, McCall & Co., Toronto, for six valves.

The Main Belting Co. of Canada, Ltd., Montreal, have appointed W. W. Hicks, 567 Banning St., Winnipeg as sales agent for that district.

The Lyman Tube & Supply Co., 33 Melinda Street, Toronto have appointed H. E. Breuls their city salesmon. Mr. Breuls is specializing on chain drives.

A. S. Clarson, C.E., the newly appointed city engineer of Verdun, Que., has been for the past five years, principally engaged as engineer of the electrical commission of the City of Montreal. He was born in England and before coming to Canada was engaged in several important engineering works.

The Lyman Tube and Supply Co., 323 St. James St., Montreal have opened a New York office for the purpose of purchasing machinery and other equipment for the benefit of their customers and so that material can be shipped from stock. K. E. Gury, formerly with the Driggs Ordinance Co. will be in charge of the New York office, located at 2606 Equitable Bldg.

Assiniboia, Sask.—The Town Council have let the following contracts for the construction of a waterworks system: One internal combustion engine, Boving Co. of Canada, Ltd., Lindsay, Ont.; generator, switchboard, and other apparatus, Canadian Westinghouse Co.; pumps, motors, piping, and air compressor, James Ballantyne & Co.; one pneumatic storage tank, Canadian Allis-Chalmers, Ltd.; poles, wire, and line material, Northern Electric Co.; about 17,500 feet of cast iron or steel pipe and specials, Canada Iron Foundries; hydrants, gate valves, and boxes, T. McAvity & Sons.

Renfrew, Ont.—Power development works have been commenced by M. J. O'Brien of Renfrew at Calabogie village, situated at the foot of Lake Calabogie, an expansion of the Madawaska River. It is the intention to build dams and erect a power-house for the generation of 5,000 h.p., which will be transmitted either partly or wholly to Renfrew, a distance of twenty miles. A dam twenty-eight feet in height will be built on the site of an old mill of the pioneers, and beside it will be the power-house. The total cost of the whole development will approximate half a million dollars.

Change of Firm Name.—The engineering work at the Provincial Hospital for the Insane at Whitby, Ont., which was designed by MacMullen, Riley & Durley, consulting engineers, Montreal and Toronto, will be carried to completion by the firm of MacMullen, Riley & Angus who have taken over the unfinished work of the former firm. Mr. Angus whose name appears in the new organization is well-known in engineering circles in Toronto and has been for some years practising his profession in that city. The new firm will continue the design of heating, ventilating, plumbing and electrical equipment of buildings as carried on by them separately in the past and will also specialize in the building design and equipment of industrial plants.

STOP
The Leaks!

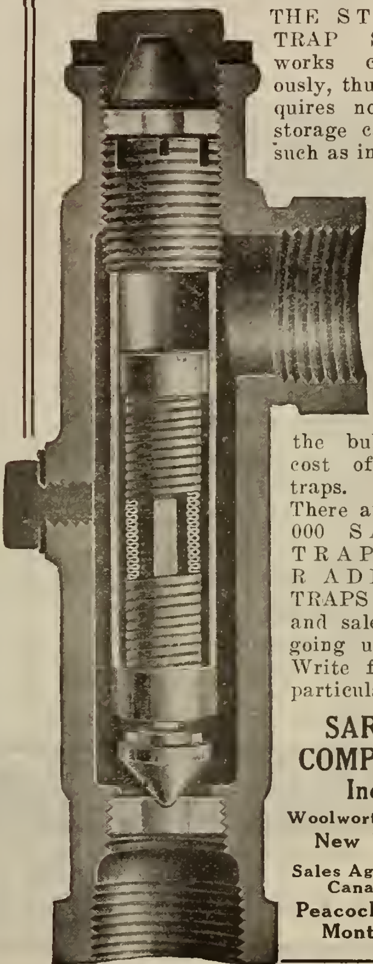
Mr. Engineer: Do you realize how much fuel and power you are wasting by using steam traps that need frequent repairs?

Every ounce of steam you lose costs money. Why not utilize all the power you pay for by installing the STEAM TRAP SARCO. It can be supplied for any pressure and is the only Thermostatic Trap successfully operated on high pressure steam lines. It is the simplest form of trap manufactured or sold since there is practically nothing to get out of order. There are no valves, gauges, packing, stuffing boxes or other trouble causers to take up your time or require constant attention.

A new Sarco costs less than repairing an old bucket or float trap.

The Steam Trap SARCO

can be adjusted instantly, and we guarantee that when adjusted no live steam can escape.



THE STEAM TRAP SARCO works continuously, thus it requires no large storage capacity such as increases the bulk and cost of other traps.
There are 350,000 SARCO TRAPS and RADIATOR TRAPS in use and sales keep going up.
Write for full particulars.

SARCO COMPANY, Inc.
Woolworth Bldg.
New York

Sales Agents in Canada:
Peacock Bros.
Montreal

Classified Advertisements

USED POWER EQUIPMENT.

ENGINES.

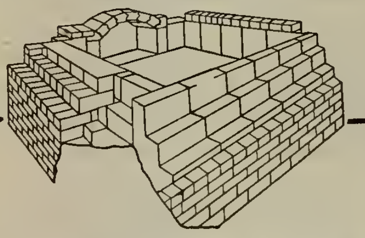
75 H.P., 16 x 36 Leonard Corliss, used less than year; heavy duty type.
85 H.P., 13 x 30 Brown automatic, excellent condition.
75 H.P., 12 x 30 Inglis Corliss
75 H.P., 12 x 12 Robb high-speed.
20 H.P. Robb high-speed.

BOILERS.

72 x 18 horizontal return tubular, shaking grates, Government inspected.

GENERATORS AND MOTORS.

200—300-light dynamos.
20, 25, 35, 250-volt motors.
50 H.P. gas engine and producer, good as new, at great bargain.
Hobbs & McGill, Mail Building, Toronto, Ont.



Gates Boiler Furnace

Patent Applied For

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

—*WRITE FOR PARTICULARS*—

John W. Gates, 382 St. James St., Montreal, Que.

GENUINE

ARMSTRONG STOCKS AND DIES

MALLEABLE IRON HINGED PIPE VISES, PIPE CUTTERS, PIPE MACHINES.

MANUFACTURED BY

THE ARMSTRONG MFG. CO.

298 KNOWLTON STREET

BRIDGEPORT, CONN.

NEW YORK: 248 CANAL STREET

Catalogues

The Lagonda Manufacturing Co., Springfield, Ohio, are distributing their 16-page booklet, published every year or so as a general reminder and concise catalogue of all the specialties in the "Lagonda" line. The booklet which is entitled "Lagonda" Boiler Room Specialties, illustrates and describes the different types of "Lagonda" tube cleaners and other specialties, one page being devoted to each. The large catalogues are referred to for more detailed information. The booklet will be gladly sent upon request to any engineer who is interested enough to write for it.

The McAlear Mfg. Co., Chicago, Ill., have issued a reference book on the McAlear system of vacuum and vapor heating, which deals with the subject in a comprehensive manner. In addition to a full description of the system, the book contains complete particulars of the various parts and their construction, method of operation and directions for installing. The illustrations include details of the traps and pumps and also several diagrams showing various systems and applications. Copies of this book may be obtained from Arthur L. Leitch, Kent Bldg., Toronto.

The Dearborn Chemical Co., Chicago, Ill., have issued a very attractive and well gotten up booklet entitled "Water," which deals with the "Dearborn" treatment of boiler feed water. The subject is discussed under the following heads:—Corrosion, incrustation and foaming, the cause and effect in each case being dealt with in a scientific, yet practical manner. Particulars are given of the principal scale—forming solids and the reason why they are harmful, while the subject of electrolysis is also discussed. The illustrations show excellent exterior and interior views of the company's factory and offices, while the covers have a very artistic and attractive appearance. Copies of the booklet may also be obtained from the company's branch factory at Toronto.

U.S. METAL POLISH

Works Equally Well on Hot and Cold Surfaces. It Cannot Blow Up. Cleans, Polishes and Preserves all kinds of metals.

Tear this off as a reminder

Geo. Wm. Hoffman Co.,
557 E. Wash. St.
Indianapolis, Ind.

Enclosed find 10c in stamps, for which send me one large 50c can of U. S. Metal Polish Paste.

Name ....
Address ....
....

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy

A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL

(Canadian Representative)

WALTER J. FRANCIS, C E. FREDERICK B BROWN, M.Sc
M. Can. Soc. C.E. M. Can. Soc. C.E.
M. Am. Soc. C.E. Mem. Am. Soc. M.E.
M. Inst. C.E. Mem. A.I.E.E.

WALTER J. FRANCIS & COMPANY

CONSULTING ENGINEERS

Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

MacKinnon, Holmes & Company, LTD

SHERBROOKE, QUE.

We build—

COAL BUNKERS
OIL TANKS
WATER TANKS
AIR RECEIVERS

and miscellaneous plate and structural work of every description used in connection with power plants.

Give your belts a square deal by using

DIXON'S

Solid Belt Dressing

Don't let them go hungry and starve. They can't give you service unless they are properly treated.

The use of Dixon's Belt Dressing means added power to your plant, longer life to your belts.

Send for Booklet No. 222-O.

Made in JERSEY CITY, N. J., by the

Joseph Dixon Crucible Company

Established 1827

'O—22

Sliptivity
SteamCylinder

Sliptivity
Steam Engine

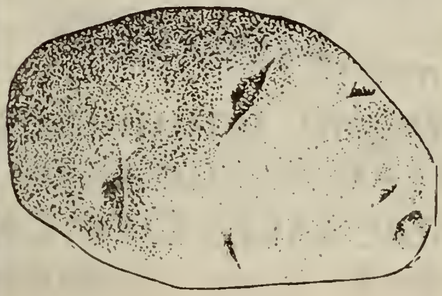
Automobile
Cylinder

OILS

These Lubricants give remarkable service. They will keep your machinery running smoothly, easily and with a minimum of wear and cost.

No better time than now to put them to the test. The prices are very reasonable.

**Potato Scale
Powder
Boiler Cleanser**



Will positively rid your boilers of old scale and will *keep* tubes clean if but a small amount is fed daily through the feed water.

Eliminates foaming, pitting or any other boiler troubles due to impurities in the water supply. *Makes big reduction in fuel bills.*

Sold UNDER A POSITIVE GUARANTEE. Try a Barrel.

C. C. SNOWDON

Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

Winnipeg—Cor. Notre Dame and Pine Sts., P.O. Box 1984.
Vancouver—823 Powell St.
Calgary—1810-1840 Eleventh St. E., P.O. Box 1384; P.O. Drawer 166.
Edmonton—Cor. 13th Ave. and 83rd St., P.O. Box 877.

Good things for
the POWER PLANT

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE
112 St. James St. Montreal

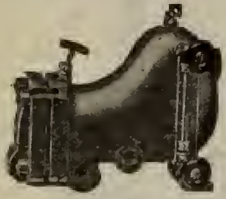
NOTICE TO Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, W. C. McGHIE,
Minister of Public Works and Highways. Chairman of Board.



McDANIEL IMPROVED STEAM TRAP

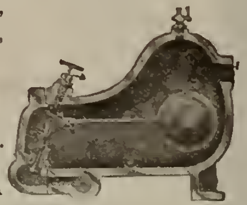
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

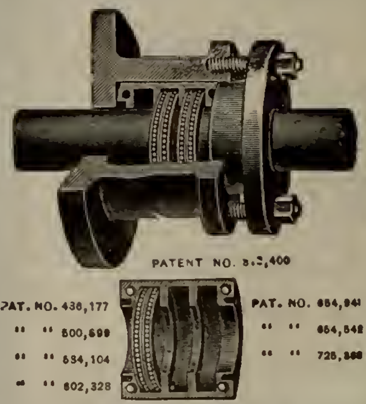
MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig Street MONTREAL, CAN.
WATSON & McDANIEL CO.
No. 146 N. 7th Street, PHILADELPHIA, Pa


PATENT NO. 552,400
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" " 534,104
" " 602,328
PAT. NO. 654,941
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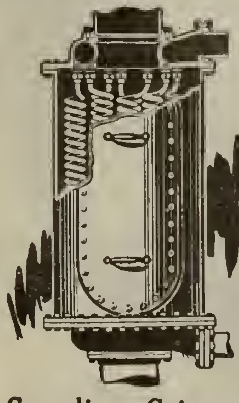
Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.



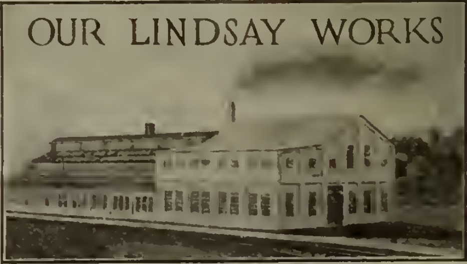
Reilly Multicoil Feed Water Heater

Has greater capacity per square foot of heating surface than any other type of closed heater. It is simple in construction, light in weight and small in size.

Write for Bulletin No. 210.

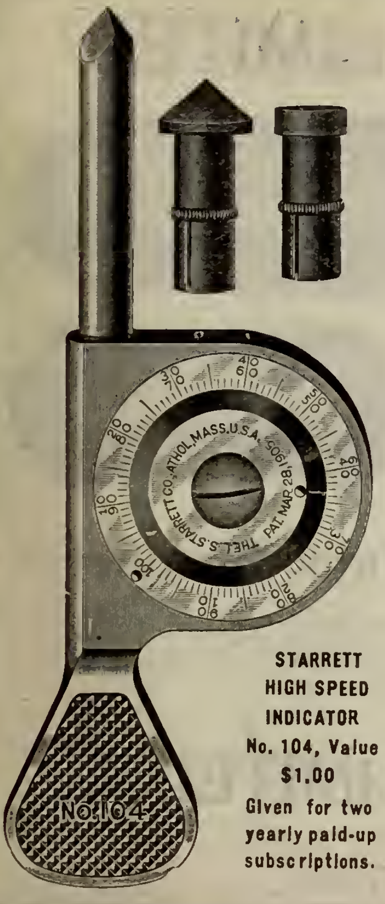
Canadian Griscom-Russell Co., Ltd.
960 St. Paul Street, Montreal, Quebec

Water Turbines, Hydraulic Governors, Centrifugal Pumps


OUR LINDSAY WORKS

Boving Hydraulic & Engineering Co., Limited
LINDSAY, ONTARIO

You May Have This Speed Indicator without Spending a Cent



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No. 104, Value $1.00
Given for two yearly paid-up subscriptions.

if you are a subscriber to "THE POWER HOUSE." If you are not a subscriber, send in your own subscription together with two others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two NEW yearly paid-up subscriptions we will send this $1.00 indicator.

"THE POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you this handy indicator without any trouble. Try it and see how easy it will be.

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Start in TO-DAY to earn one of these Handy Tools

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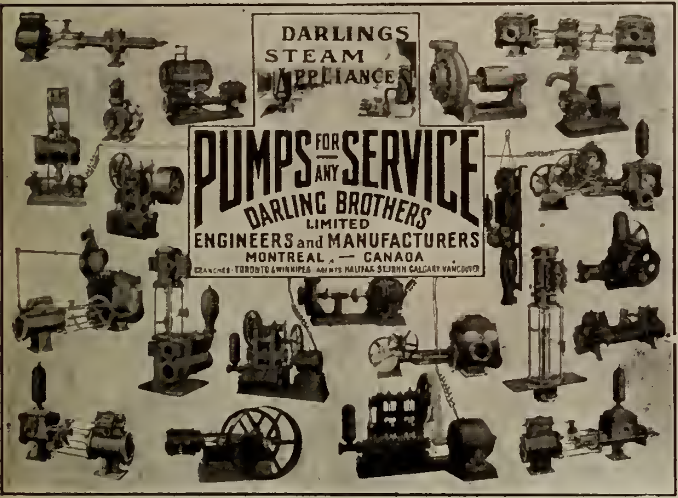
DARLINGS STEAM APPLIANCES
PUMPS FOR ANY SERVICE
DARLING BROTHERS LIMITED
ENGINEERS and MANUFACTURERS
MONTREAL, — CANADA
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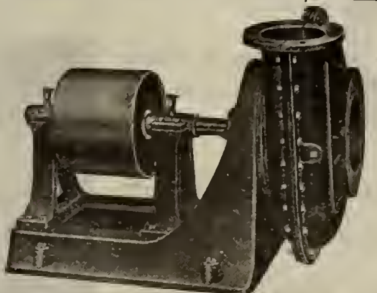

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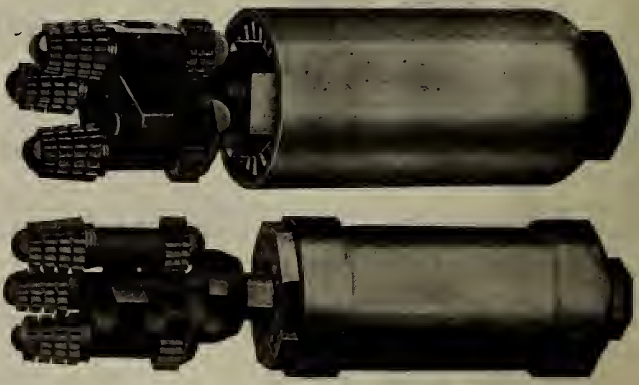

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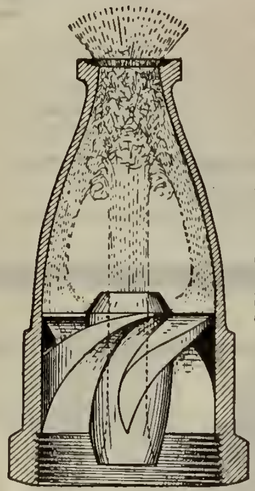

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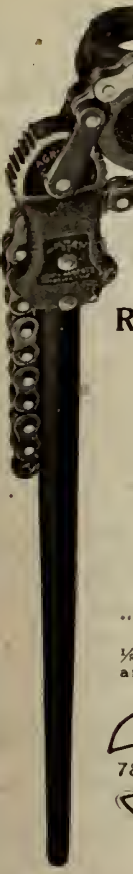

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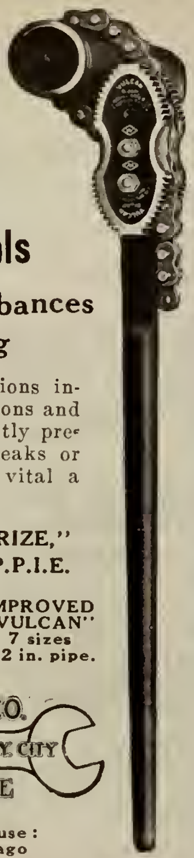

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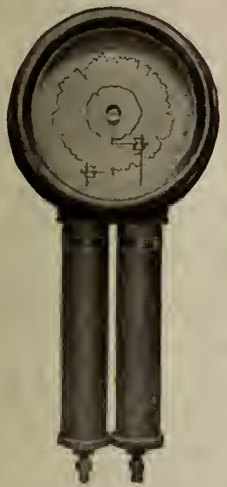

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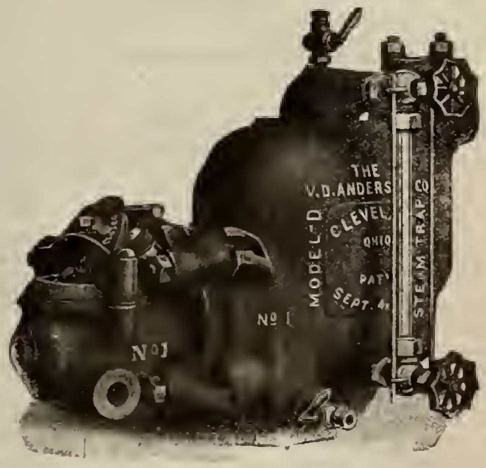

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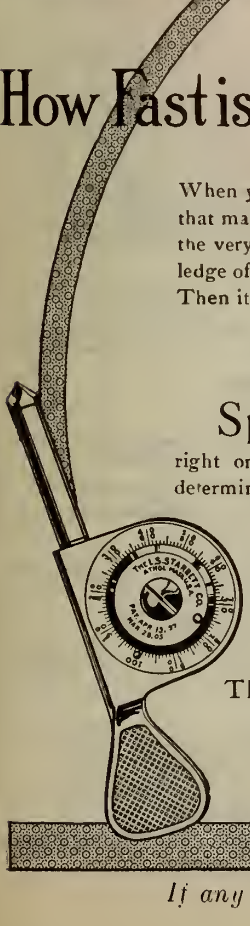

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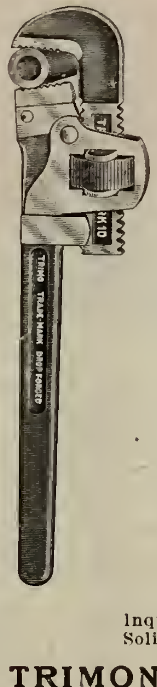

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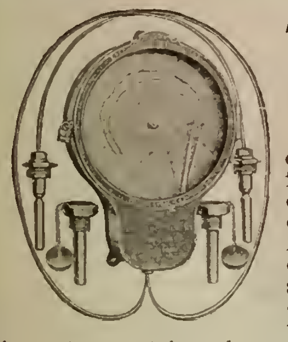

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Vol. IX. TORONTO, NOVEMBER, 1916 No. 11

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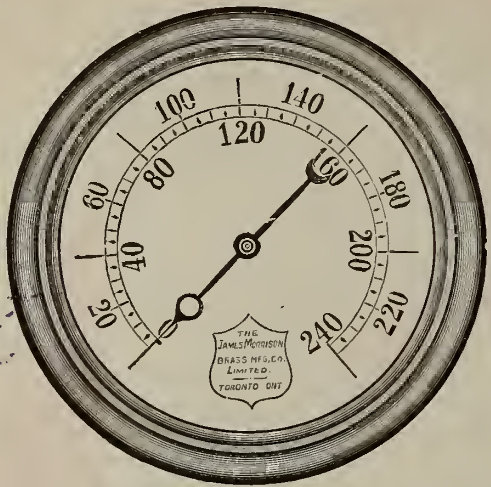

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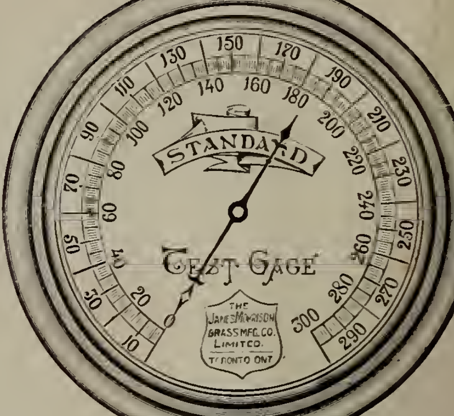

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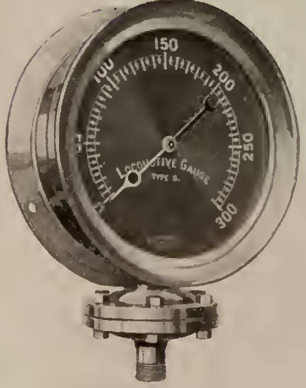

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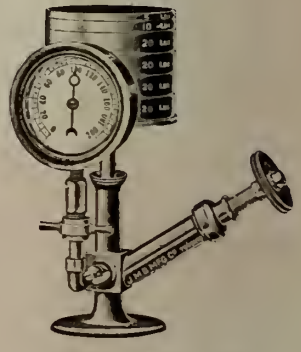

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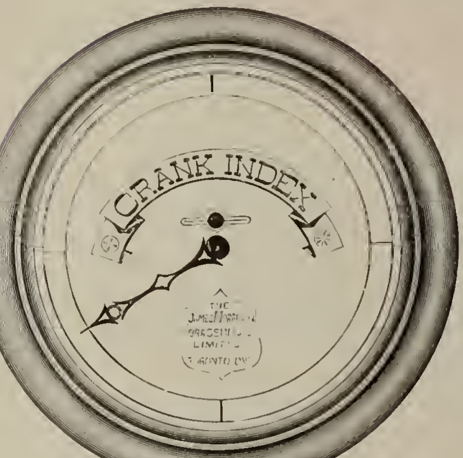

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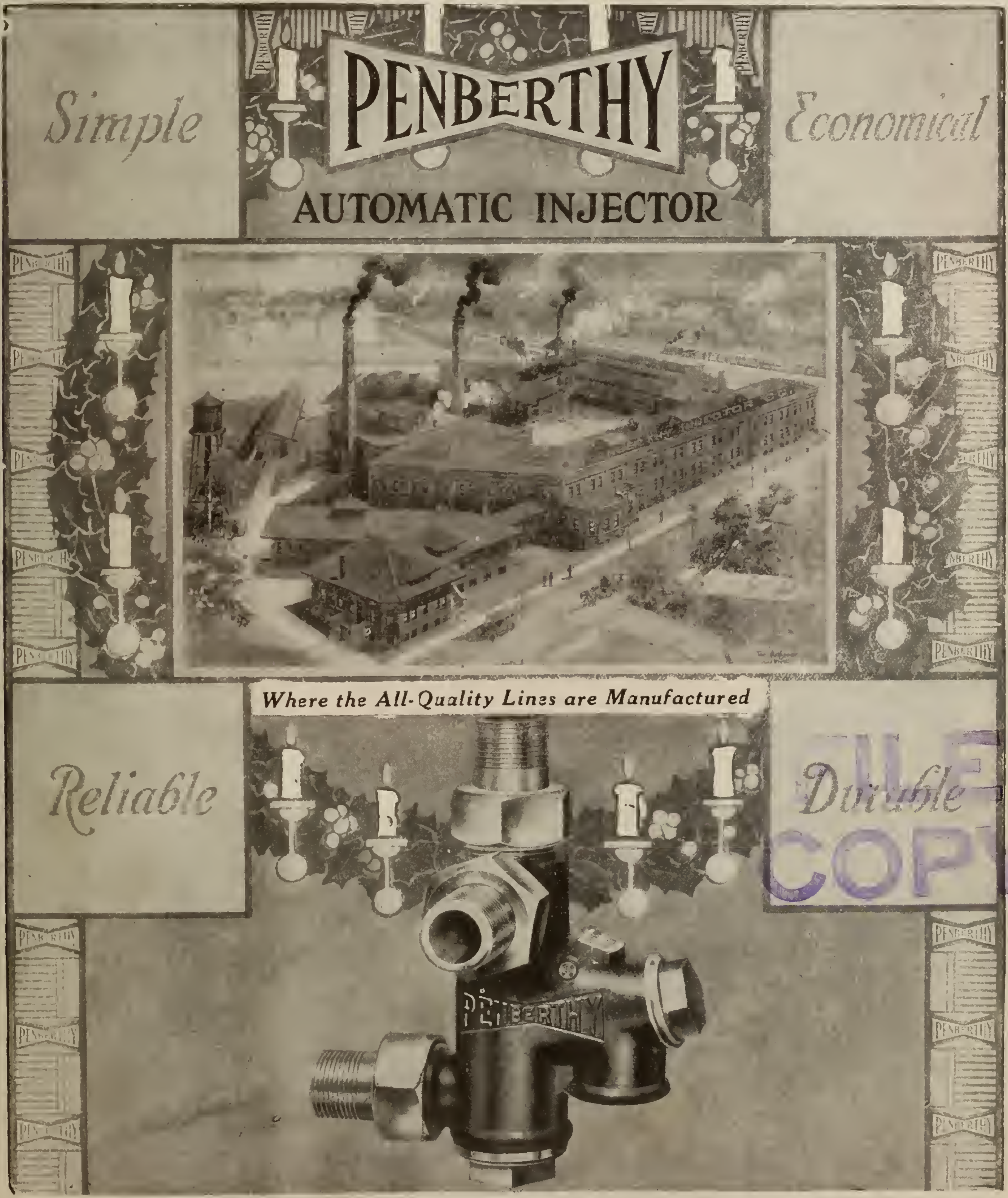

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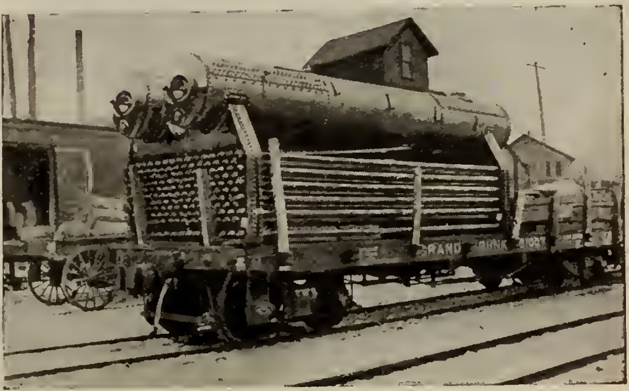

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And ALL KINDS OF TANKS like this

Also all kinds of Marine Boilers, Land Boilers, Plate Work, etc.

Send us your specifications and blue prints.

POLSON IRON WORKS, LIMITED

SHIPBUILDERS, ENGINEERS AND BOILER MAKERS

TORONTO, ONTARIO

Underfeed Stoker Equipment

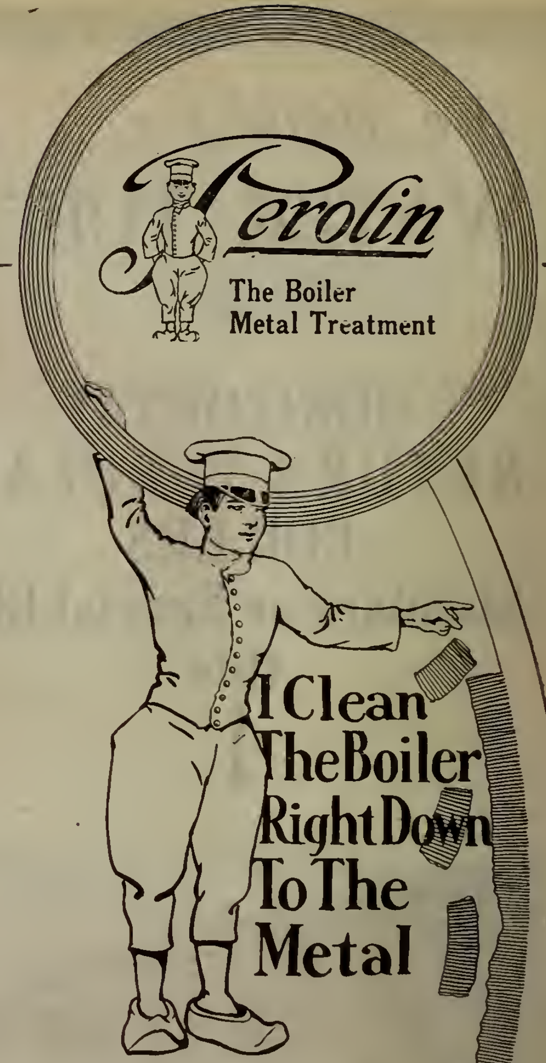
It not only gives you a sure, efficient and scientific feed to your fires, but it actually saves up to 25% on your coal bill. It is a common saying that where Jones Underfeed Stokers are installed the chimneys never smoke. You know what that means. You know the value received from such a system.

Simplicity of construction and operation, no parts moving in contact with the fires, no grates, no loss through bars, and less labor. Attention and worry regarding the condition of your fires cease.

We will be judged by our product. Write us and we will put you in touch with users near you.

Jones Underfeed Stoker Co.

National Trust Building
Toronto, Canada


Perolin
The Boiler Metal Treatment
I Clean The Boiler Right Down To The Metal

AND then I keep the scale from baking, so that the boiler remains clean. That's why Engineers who have been experimenting unsuccessfully with boiler compounds that treat the water always like my method.

You see I don't treat the water at all. I know better. The only unchanging element in the generation of steam is the boiler metal, and on this I concentrate all my activities, spying out the cracks in the scale and wiggling my way through to the boiler plate, drawn in by my strong affinity for hot metal. There I push off the scale in small pieces and form an amalgam or surface on the metal that prevents new scale from forming. **Better try me.**

The Perolin Co. of Canada, Ltd.

Office and Factory: 858 Dupont St., Toronto, Can.

Western Agents: The Engineers Supply Co., Winnipeg, Man.; The Western Supply & Equipment Co., Ltd., Calgary, Edmonton and Lethbridge; Bayfield & Archibald, 334 Seymour St., Vancouver, B.C.

Perolin Company of Canada, Ltd.,
858 Dupont St., Toronto, Ontario.

Please send me the full story of Perolin.

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Address ....

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Company Name ....

SAVE THEIR COST IN 6 MONTHS

THE McNAUGHTON ROCKING GRATE BAR
THE GALT SPRINKLER STOKER

MADE IN CANADA

It will pay you to investigate. Drop us a postal.

The Galt Foundry Co., Galt, Ontario

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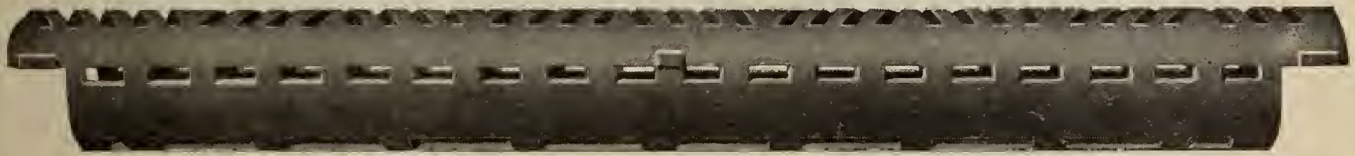

Increase steam—Save fuel—Save labor—Cost less—Reduce smoke.

Shipped from Hamilton, Ont. **Let us give you complete information**

FOR ALL PROBLEMS—**Steam—Grate Bar—Furnace—write THOMAS**

THOMAS GRATE BAR CO., Birmingham, Ala., U.S.A.

JENCKES

Vertical Tubular
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Locomotive Tubes
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BOILERS

We have a large stock of Plates and Tubes

Write or Wire us for Prices and Shipment

The Jenckes Machine Co., Ltd.

Works: Sherbrooke, Que. St. Catharines, Ont.

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THE simple matter of buying goods at one price and selling at another never made a successful business. The *Element of Service* is what adds permanence to any organization, and the success of such organization is measured only by its ability to serve. The factor of *SERVICE*—to the customer—always has been, and is, what has guided us in making connections with manufacturers of power plant specialties.

WE have had many years' experience solving difficult power plant questions, of all kinds and conditions, and the benefit of this experience is yours in dealing with us. If your conditions are not suitable for equipment supplied by us, we do not hesitate to advise what we think will overcome your difficulties.

ON this, and the opposite page, a few of our lines are shown. In our opinion, after long experience, with many tests and trials, they are the best, will stand up the longest, and give the most efficient service, of any that are made on the continent.

H. L. Peiler & Co.

311 Kent Building, Toronto, Ont.
380 St. James St., Montreal, Que.

We solicit your enquiries.

You, Mr. Engineer

can greatly reduce your firm's fuse expense—in fact you can cut it down 80 per cent. by using

"ECONOMY"
Renewable Cartridge Fuses

They are no experiments—millions of them are in use.

Made in Canada and sanctioned by the Canadian Fire Underwriters' Association

Free samples of any desired types and capacities sent with Catalogue No. 24. List of prominent users included

ECONOMY FUSE & MFG. CO. OF CANADA, LIMITED
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Manufacturers in Canada of "S. & C." High Potential Fuses,—to 150,000 Volts

MASON

Reducing Valves

Pump Regulator
Balanced Valves
Damper Regulators

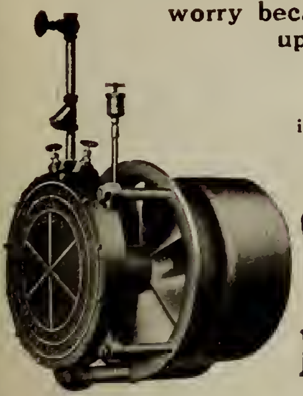
If you order a Mason you will get absolute satisfaction. This we guarantee you. You simply cannot make a mistake.

Dependable regulation under every possible condition.

Our complete catalog tells you WHY. Let us mail you a copy.

Mason Regulator Company
BOSTON, MASS.

CANADIAN AGENTS
H. L. PEILER & CO., MONTREAL and TORONTO



WHY

worry because you cannot keep up steam pressure

WHEN

it is so easy and cheap to overcome your difficulties by installing a

COPPUS TURBO BLOWER

It means constant steam pressure, regardless of uneven loads, poor draft and poor coal, and it will pay for itself in a short time on account of better combustion. It also will increase your boiler capacity to 200, and even 300%, of its normal rating without injury to the boiler. Cut out this Ad., put your name and address on the margin and mail to us. Without further trouble you will get all the particulars.

500,000 H.P.

in boilers equipped with Coppus Turbo Blowers in four years.
The Coppus has replaced a great many other blowers, but no other blower has ever replaced a Coppus.

Coppus Engineering & Equipment Company
167 Union Street, Worcester, Mass.
Canadian Sales Agents:
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Bundy Steam Traps

When you get heat into water, keep it there! Keep it there and hold it there as long as possible, no matter where the water goes. This is the idea which the makers of the

BUNDY STEAM TRAPS

have been driving home to power plant men for years.

BUNDY STEAM TRAPS
combine Power, Simplicity and Efficiency

Nashua Machine Company
Manufacturers
Nashua - New Hampshire

H. L. PEILER & CO.
380 St. James Street - - Montreal
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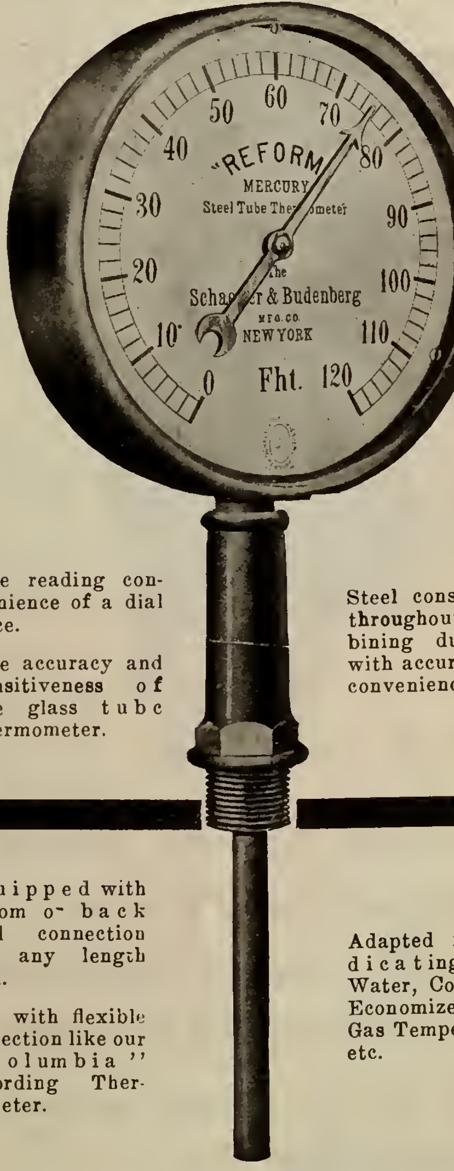
"REFORM"
Mercury Actuated Dial Thermometer



The reading convenience of a dial face.

The accuracy and sensitiveness of the glass tube thermometer.

Steel construction throughout, combining durability with accuracy and convenience.

Equipped with bottom or back rigid connection and any length stem.

Also with flexible connection like our "Columbia" Recording Thermometer.

Adapted for indicating Feed Water, Condenser, Economizer, Flue Gas Temperatures, etc.

Ask for Pamphlet
W-101

THE Schaeffer & Budenberg MFG. CO.

Makers of "Columbia" Recorders, "Crescent" Thermometers, S & B Gauges, Tachometers, Counters, Calorimeters, Indicators, etc.

Berry and South 5th Streets, Brooklyn, N. Y.
Also Chicago, Philadelphia, Pittsburgh.

"McAVITY" Improved

Side Outlet Brass Pop Safety Valve

Lockup Pattern

Approved by the Governments of the Provinces of Ontario, Alberta, Saskatchewan and British Columbia.

For use on boilers carrying pressures up to and including 200 lbs.

T. McAvity & Sons
LIMITED
Hardware and Metal Merchants,
Brass and Iron Founders
St. John, N.B. - - Canada
Montreal Winnipeg

Mechanical Regulation of Boiler Feed Water

By the use of the "S-C" method you are assured of a continuous feed at all times load is on boiler. The graduation in rate of feeding is entirely dependent upon the load and fire conditions. The Regulator will carry a constant level on steady load—higher level on light load and lower level on peak loads. Variation in water level is entirely dependent on inclined position of generator which is adjustable while operating under full load.

Bulletin No. 80 explains all.

Generator or Actuating end of Regulator.

Regulating Valve Placed at Any Point, Any Position.

The "S-C" Regulator Company
Feed Water Regulation Engineers
FOSTORIA, OHIO, U.S.A.

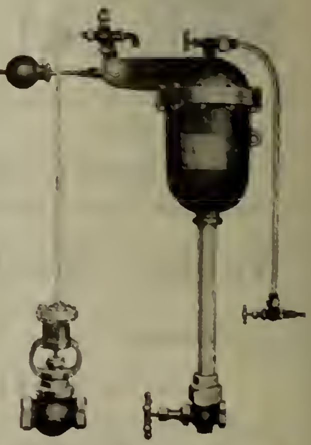
Once Is Too Often

Once Is Too Often for Accidents to occur due to high or low water. They can be prevented and should be prevented.

The **Vigilant** provides absolute prevention from dangers from this source. The heavy displacement used is positive acting under any conditions. It keeps water level always within ¼ in. of middle gauge. There is nothing about it to get out of order—its construction is very simple.

The economy of the **Vigilant** is another point. It actually pays for itself, as it effects a saving in coal of from 3 to 17 per cent—this from accurate record.

We have a set of engineer's data cards for you. They'll prove very useful. Send for them to-day.



The Chaplin-Fulton Manufacturing Co.
28 Penn Ave., Pittsburgh, Pa.

A Well-Insured Plant

is the power plant of the Ft. Worth Light, Heat and Power Co., Texas. On the inside the coal is stored above the boilers in a Brownhoist Concrete Bin, which time has proved will last as long as the plant and require no repairs. The coal is unloaded on the outside by a Brownhoist Locomotive Crane, which takes it from the cars and places it in storage or puts it through the roof into the Brownhoist Bin. It is safe to say that this plant will have very little trouble, if any, with its coal handling apparatus.

BROWNHOIST

Concrete Coal Bin and Coal Handling Machinery

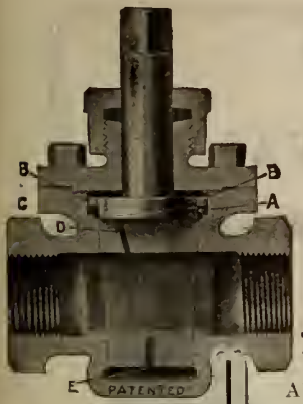
Write for Catalog S

The Brownhoist Concrete Bin is a steel bin, lined inside and out with concrete. This protects all steel from the corrosive action of the coal or ashes. The oldest one of these bins has been in continuous service for 14 years and has required no repairs. Brownhoist Coal Handling Machines are of various types and sizes for safe, rapid and economical handling of coal. These machines and the bin are described and shown in Catalog S.

The Brown Hoisting Machinery Co.

CLEVELAND, OHIO

Branch Offices in New York, Pittsburgh, Chicago, San Francisco, Montreal and (Portland, Ore., Colby, Eng. Co.)



Homestead Valves

Built for Harder than Usual Service

Although built to withstand exceptional service the Homestead valves open and shut easily. The patented balancing parts ensures against sticking.

When the Homestead Valve is fully opened the two surfaces which are depended upon for tightness are in no way affected by the material passing through. The plug cock provides a straightway opening which is desirable in all sorts of work. Important in high pressure service.

If you have heard or seen them you know their splendid quality. If you are not acquainted write us for an introduction. It will be to your advantage.

Homestead Straightway, Three-way and Four-way Valves.

Homestead Valve Mfg. Company
PITTSBURGH, Pa.
Works: Homestead, Pa.

CURTIS

Engineering Specialties

CURTIS Water Pressure Regulator

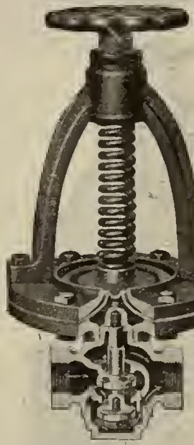
The Economy of this Curtis Water Pressure Regulator (See Illustration) lies in the fact that it greatly reduces the cost of keeping plumbing in order—This by obviating the wear and tear of water hammer or concussion in pipes.

This regulator is warranted to maintain the pressure desired, **with perfect uniformity, regardless of any fluctuations of outside pressure.** The workmanship and material of the Regulator **cannot be excelled.** Trouble from rust or clogging is **entirely avoided.** Delivery of water into service pipes at any desired pressure **is guaranteed.**

Send for special leaflet and price list to the manufacturers.

JULIAN D'ESTE COMPANY

26 Canal Street, BOSTON, MASS.



The Season's Greetings to you and yours, with the sincere wish that during the coming year you will be blessed with happiness and prosperity.

The Lunkenheimer Co
Cincinnati

32-9-43

KERR

("New KEYSTONE" Pattern) GATE VALVES

If you have not used any of these New Pattern Valves, specify "KERR" in your next order. We want you to get acquainted with the most reliable valve on the market.

If you have been using them, we are confident that our satisfaction will bring us your repeat orders. These valves will never cause you or your customer the slightest trouble. Their high quality is consistent.

When you buy a "KERR" Valve you get a guaranteed article that is backed by a reliable firm. Many of the largest distributers of valves in Canada have sold "KERR" Valves for over 25 years, and are still recommending them as the "Best Valve." Write us for particulars.

Kerr Engine Co., Ltd., Valve Specialists **Walkerville, Ont.**

From the time when put in service and for years after they are installed

JENKINS BROS.'

TYPE "K"

BRASS GATE VALVES

TRADE JENKINS MARK
Jenkins Bros.

are a source of satisfaction to the user. With a little attention now and then they will give *permanent* service and satisfaction.

They do not give out or require replacement, because in their manufacture the most careful attention is given to every detail in design, material and workmanship.

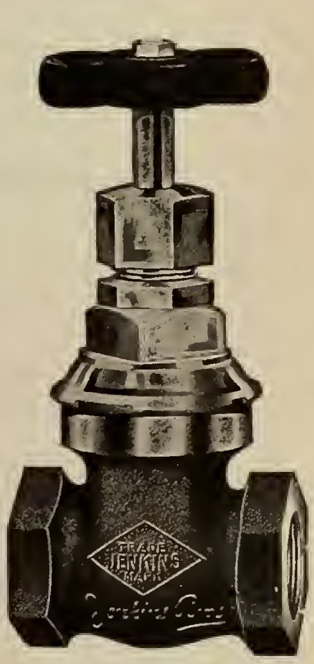


Fig. 300
TYPE "K"
BRASS GATE VALVE
(Screwed)

Approved for use in Ontario and the Western Provinces by the Depts. of Public Works.

WRITE FOR CATALOGUE No. 8

TRADE JENKINS MARK
Jenkins Bros

Jenkins Bros. LIMITED

TRADE JENKINS MARK
Jenkins Bros

103 ST. REMI ST. MONTREAL

"Boiler Scale Troubles have ended"

This is the proof of the efficiency of

"Imperial" Boiler Coating

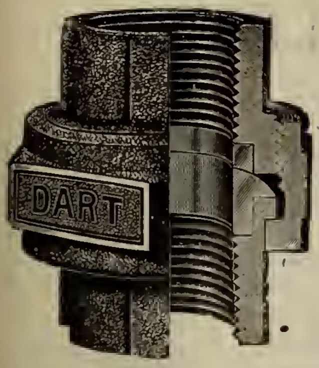
that is reaching us by every mail. Imperial Boiler Coating has never failed to remove scale where it has been given fair trial—and because of this we are willing to send you a sufficient quantity to satisfactorily treat your boiler against scale formation on the fair basis of "**satisfaction or no pay.**"

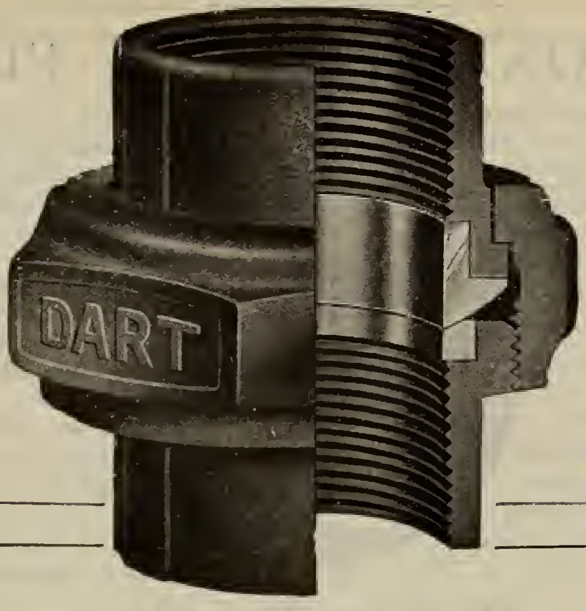
Imperial Boiler Coating is not a compound and there are positively no acids, graphite or other harmful ingredients in it.

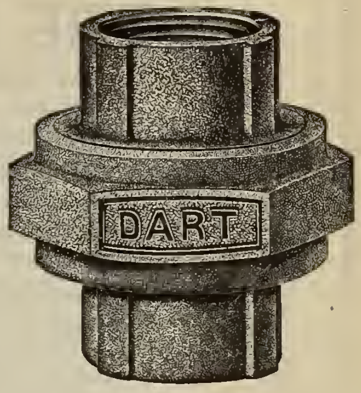
Try it and you'll want more.

Drop us a line to-day for prices, etc.

Crown Manufacturing Co.
CLEVELAND
OHIO







The Joint——

Bronze to Bronze

That feature is the secret of the everlasting quality of the Dart Unions. The ball-shaped seat will allow it to be easily and effectively adjusted on a pipe that is out of alignment.

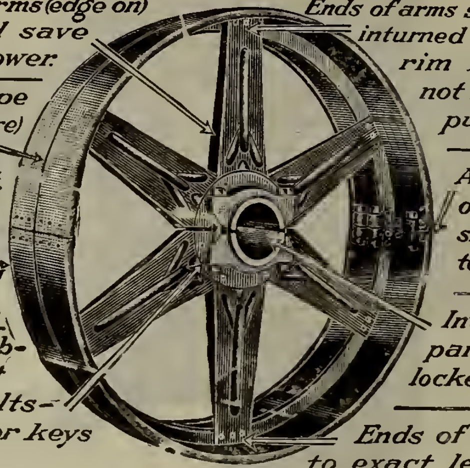
Efficiency is here proven and to back up our claim we put a guarantee on every Union stamped with our Dart trade mark. If you should find a defective union we will replace it with two perfect ones. We are confident.

Never corrodes. Easily connected.

Manufactured By

Dart Union Co., Limited
Toronto, Ont.

THE MOST EFFICIENT PULLEY



Flat "A" braced arms (edge on) cut-the air and save enormously in power.

Grooved air escape (an exclusive feature) diminishes air cushion under belt.

A rim made The only correct crown *like a channel iron central flanges and safety beaded edges.*

All steel parting hub-clamped to shaft with powerful bolts—no set screws or keys required.

Ends of arms solidly riveted to inturned strengthening rim flanges—Arms not riveted through pulley face.

A parting pulley-no occasion to strip shaft. Rims doweled together at bead.

Interchangeable parting bushings locked to pulley hub.

Ends of arms all milled to exact length.

Minimum Belt Slip
Minimum Power Absorbed Through Windage
Maximum Strength and Reliability

Give us a chance to prove these facts to any responsible engineer.

The American Pulley Company, 4234-60 Wissahickon Ave., Philadelphia, Pa., U. S. A.

Williams & Wilson, Limited, Montreal
The A. R. Williams Machinery Co., Limited, St. John, N.B., Toronto, Winnipeg, Vancouver

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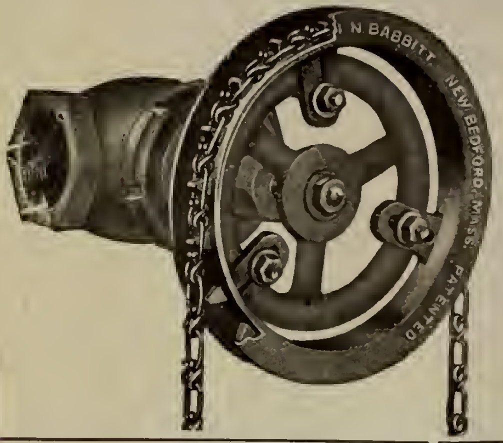


Goes Right on Your Present Valve Wheel

"Goes on" is about right, too, it's so easy to apply, and by putting a

Babbitt Adjustable Sprocket Rim

on each of those hard-to-get at overhead valves you can save a lot of time you now spend in hunting ladders and all the risk you now run in using them after you've found them. One concern that thought two would do, bought 27 in a little over two months. The price will encourage you to have enough of them.

Ask your dealer. Write for Illustrated Folder.

Babbitt Steam Specialty Co., 59 So. Water Street. **New Bedford, Mass.**

The R. E. Cleaton Co., 20 St. Nicholas St., Montreal, Que.

ROTO TUBE CLEANERS

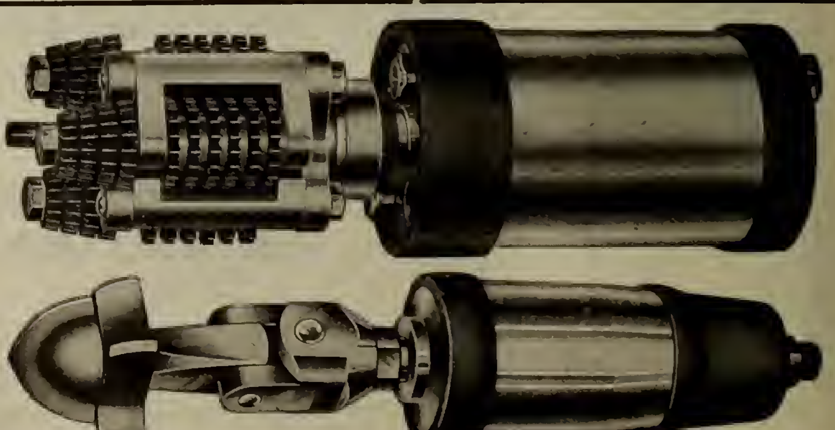
Type A D.—Driven by Air or Steam
Type W. D.—Driven by Water Pressure

More power from your boilers.
Less coal per power produced.
No burned out boiler tubes.

The only cleaners for hardest scale.
Safest and fastest for light scale.
Best for all boiler scale conditions.
Standard of the largest power plants.

THE ROTO COMPANY

Write for Catalog HARTFORD, CONN.



Mention this paper when writing advertisers. It will identify the proposition about which you require information.

This is the kind of letter we'd like to have you write—

The William B. Pierce Co.,
Buffalo, N.Y.

Gentlemen:-

I am just about as hard to convince as they make 'em.

You tell me the Dean Boiler Tube Cleaner will remove scale from my boiler tubes that other types of cleaners and methods of scale elimination can't touch. You say your Cleaner will do the work not only more thoroughly, but faster. You claim I can use it equally well in water-tube and fire-tube boilers, and thus make one Cleaner do the work of two. You assert your Cleaner is a better boiler inspector then the insurance company man, because it will show up defects in the tubes that he can't even see, much less reach. You tell me this tool costs about a dollar a year for upkeep, and with ordinarily good care will last at least fifteen years, and probably a good deal longer.

If all you say is true, you have the best boiler tube cleaner on the market and that's what every engineer worth a cent to his employer wants. I'm not wedded to any particular make of Cleaner or any speciel method for removing scale, but I'm a native-born son of Missouri and you've got to show me.

So, being an open-minded sort of chap and always willing to try a thing once, I'll give your Dean Cleaner a tryout if you'll send one along---yes, and I'll even pay the express charge one way.

BUT---and take this straight from your uncle---I'll watch **that** trial like a hawk end if you can't produce a Cleaner that will show RESULTS, you'll get it back d-----d quick.

Ship along your Dean right away.

Yours truly,

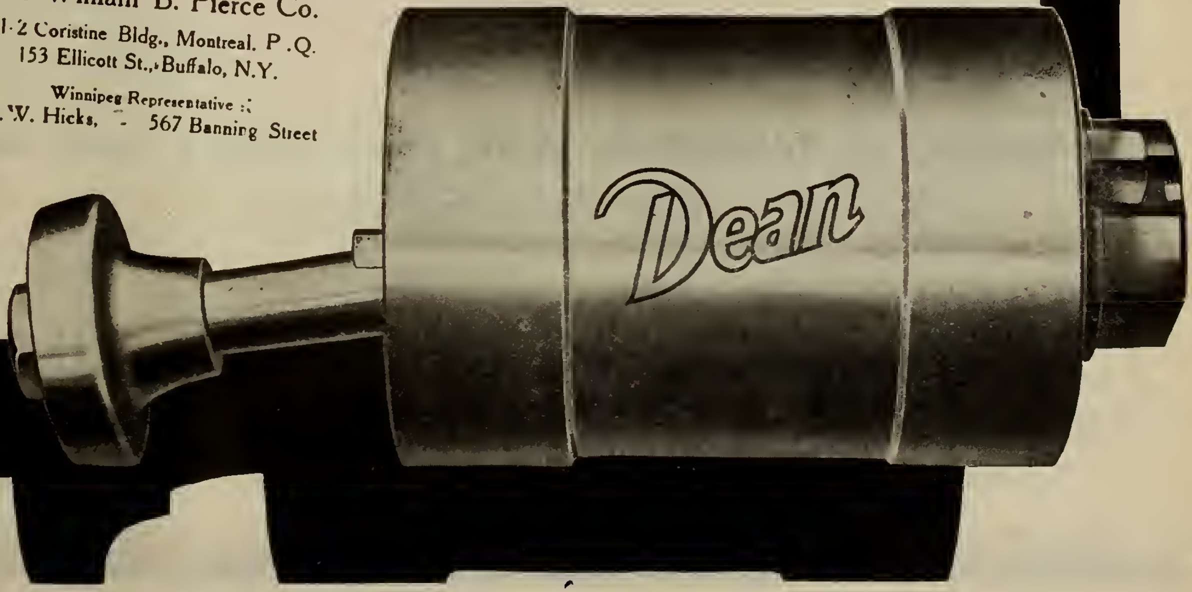
Engineer's name ______________________________

Company ______________________________

Address ______________________________

Size of tubes (O.D.) ______________ Type of boilers ______________

The William B. Pierce Co.
201-2 Coristine Bldg., Montreal, P.Q.
153 Ellicott St., Buffalo, N.Y.
Winnipeg Representative :
W. W. Hicks, - 567 Banning Street



We have the most complete Stock in Canada of

STEEL BALLS

and can make

Immediate Delivery

of anything from ⅛ inch to 5 inches.

Our Stock of

Journal and Thrust Bearings

is also complete, ready for prompt delivery

Telephone or telegraph your rush orders and we will ship the same day.

LYMAN TUBE & SUPPLY CO., LIMITED

MONTREAL
323 St. James Street

TORONTO
33 Melinda Street

Personal Buying Service in New York City

Probably you have experienced some of the great difficulty that has arisen, as a result of the present abnormal conditions in the world's metal markets, in securing materials, machinery and equipment within a reasonable time. From the mills deliveries can seldom be had in less than one to two years!

There are, however, existing stocks of all these necessities, and New York City, now the market-place of the world, is the best place to look for them

To locate these sources of supply for our customers, and so give them immediate deliveries, we have opened our own office in New York, at 2606 Equitable Building, and have retained the services of the man who is, we believe, most competent to find them—Mr. E. K. GURY, of New York City.

Mr. GURY has had many years' experience as a large purchaser of metals and machinery, and is personally acquainted with most of the big dealers in the metropolis. The way he can dig up things of which the market seems bare, and for want of which some customer of ours has been tied up, is as pleasing as it is astonishing.

This personal buying service is for YOUR accommodation. If there is anything in steel or other metals, machinery or equipment, which you have been unable to get, put it up to us. Mr. GURY will find it for you, and get you immediate delivery.

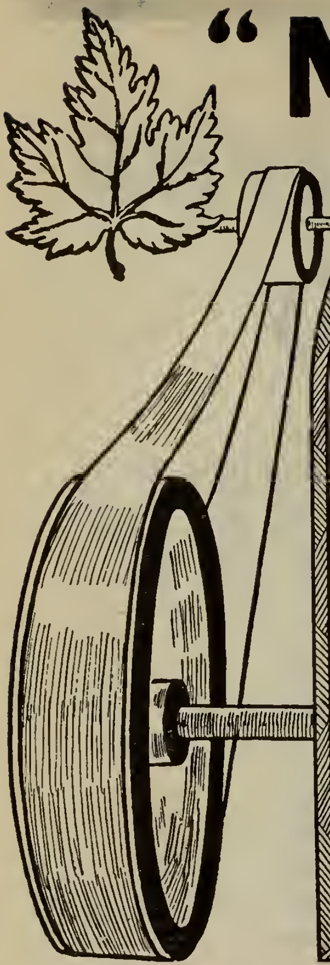
We shall, of course, continue to specialize in tubes of all kinds,

Write, telephone or wire your enquiries to our Montreal or Toronto offices, and we will act immediately for you.

LYMAN TUBE & SUPPLY CO., LIMITED

MONTREAL New York Office: **TORONTO**

2606 Equitable Building



"MAPLE LEAF"

Stitched Cotton Duck

Belting

Excels all others in economy, strength, efficiency and true running, whether for Transmission of Power or Conveying.
A test recently made at McGill University, Montreal, of 6-ply "Maple Leaf" Belting, light double leather, and 6-ply rubber, showed that our "Maple Leaf" stood a breaking strain 50% greater than the leather, and 25% greater than the rubber belt.

A trial belt will convince you.
Write for prices and samples.

Maple Leaf Belt Dressing
The BEST for all kinds of belts

Dominion Belting Co., Limited
Hamilton, Canada

TRADE MARK

TRADE MARK

DEFIES THE RAVAGES OF TIME

HAS BEEN RUNNING DAY AND NIGHT FOR FIFTEEN YEARS WITHOUT APPRECIABLE WEAR

THE CITIZENS ELECTRIC CO., LTD.

Smith Falls, Lanark Co., Ont.,
July 16, 1916.

Magnolia Metal Company,

Gentlemen:

We are in receipt of your favor of the 11th inst., enclosing copy of the letter of our Engineer (Mr. Scroggie) dated January 29th, 1911, re our line of shafting which, up to that time, had been running day and night ever since under the same conditions and the years do not seem to have any effect on it whatever—about the only thing around here which escapes the ravages of time.

You are at liberty to use this letter if you so desire.

Yours truly,

THE CITIZENS ELECTRIC CO., LTD.
Jas. S. Gould.

PRACTICAL ENGINEER POCKET BOOK:

Over 600 pages. A valuable reference work imported from England and sold as an advertising medium at the low price of 40c post paid.

Address Montreal Office.

SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

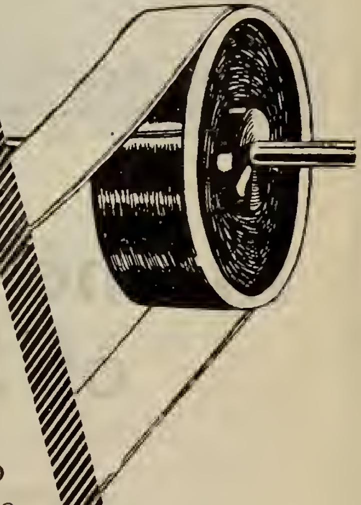
OFFICE AND FACTORY:
225 St. Ambroise St. MONTREAL

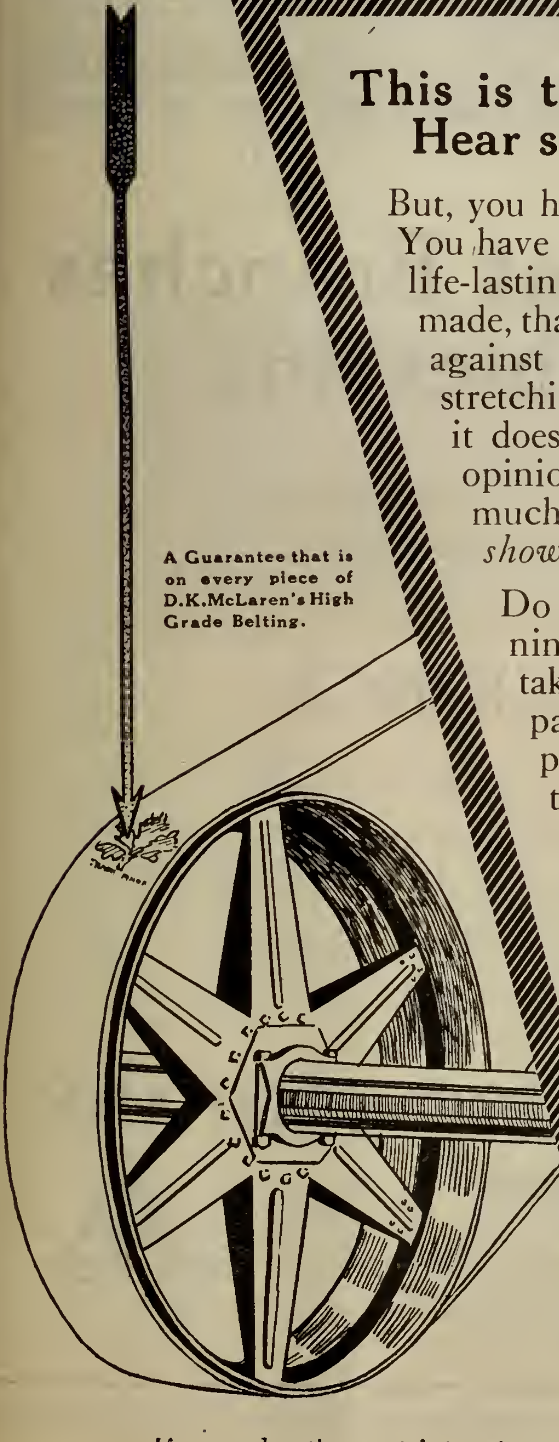
D.K. McLaren's

Genuine British Oak Tanned

Leather Belting

Genuine Oak Genuine Oak





A Guarantee that is on every piece of D.K.McLaren's High Grade Belting.

This is the Belting You Hear so Much About

But, you haven't heard all about it. You have heard that it is a non-slip, life-lasting and the best belting made, that it is practically insurance against breakdowns, loss of power, stretching. But have you heard *why* it does this? You won't take the opinions of other people when so much is at stake, you have to be *shown.*

Do you know, that from the beginning the steer on the plains, care is taken right up to the stamping and packing? During the making expert attention is given every operation. Inspection on every inch is strict. Great care is taken in the tanning and cutting. It pays us to give this extra attention, and the length of our list of prominent users would also convince you.

Write us to-day.

D. K. McLaren, Ltd.

Head Office and Factory:
351 ST. JAMES STREET, MONTREAL, P.Q.
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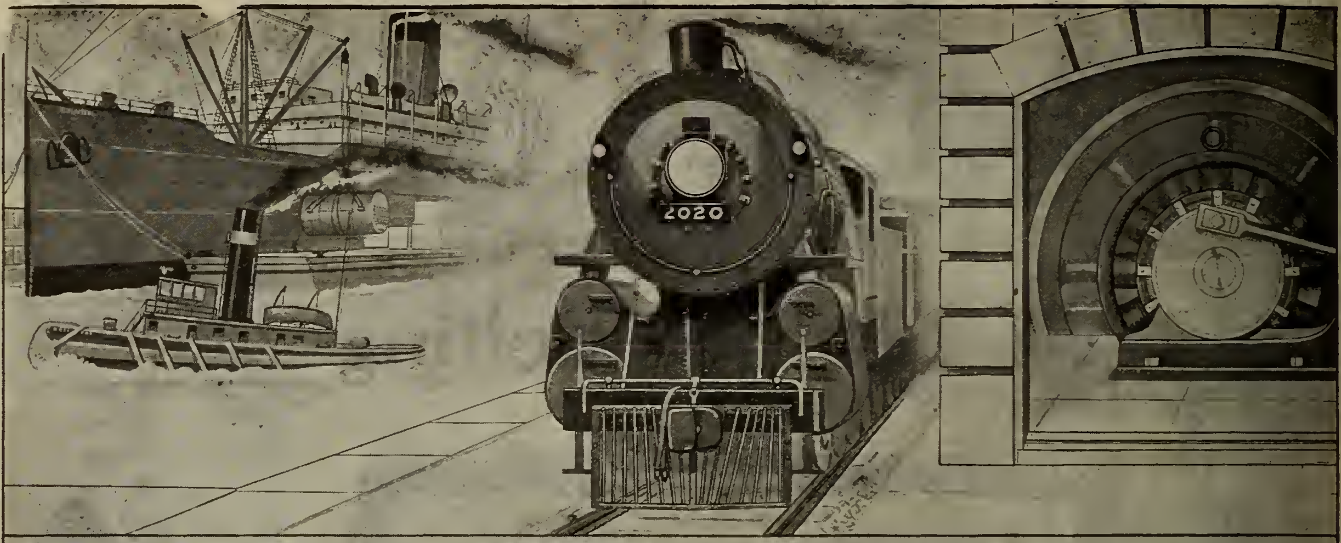
ENGINEERS SUPPLY CO., 123 Bannatyne Ave. East.
Winnipeg, Man.



GARLOCK PACKINGS ARE USED EXTENSIVELY BY THE GREATEST RAILWAY AND STEAMSHIP LINES AND IN THE LARGEST STATIONARY POWER PLANTS THROUGHOUT THE WORLD.

In the Three Great Branches of Steam Engineering

Where speed and economy are paramount, where a hot rod or blown-out gasket might mean a schedule broken or contract lost,

GARLOCK PACKINGS

are used generally. Under the most trying conditions of service Garlock Packings have proved their superiority. Let us suggest a cure for that rod or joint that "won't stay packed." We invite you to submit your packing problems.

THE GARLOCK PACKING COMPANY

Hamilton, Ontario

Branches:

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Toronto, Ontario - 404 Continental Life Building
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THE BELT WITH A GRIP

"Lincona"

BALATA BELTING

will pick up a load suddenly better than any other type of belting

BECAUSE

it has a GRIP that no other belting has and requires no dressing.

"Lincona" will give you the maximum transmission of power

"Lincona" is the strongest Balata Belt Made.

The tensile strength of "Lincona" is almost double that of leather belting and there is less stretch and straighter running than any other type of belting.

The secret of the greater strength of "Lincona" Balata Belting is in making the Balata a fluid which will saturate the duck, instead of a paste placed on and rolled in. The fluid Balata used in the "LINCONA" process also allows the duck to be compressed more closely, so producing a Belt thinner for the number of plies. This gives a stronger wearing surface to the pulley and less friction.

"Lincona" Balata Belting can be exposed to snow, rain and every condition of weather without injury. It can be run in water without trouble. Write us about your specific needs.

Manufactured by

JAMES DAWSON & SONS, LIMITED, - LINCOLN, ENGLAND

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SteamCylinder

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Automobile
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OILS

These Lubricants give remarkable service. They will keep your machinery running smoothly, easily and with a minimum of wear and cost.

No better time than now to put them to the test. The prices are very reasonable.

**Potato Scale
Powder
Boiler Cleanser**

Will positively rid your boilers of old scale and will *keep* tubes clean if but a small amount is fed daily through the feed water.

Eliminates foaming, pitting or any other boiler troubles due to impurities in the water supply. *Makes big reduction in fuel bills.*

Sold UNDER A POSITIVE GUARANTEE. Try a Barrel.

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Oils Refiner, Manufacturer and Importer, Pennsylvania, Lubricating and Refined Oils, Gasoline, Potato Scale Powder, Liquid Soap, Disinfectants, Polish, Waste, Oil Tanks, etc.

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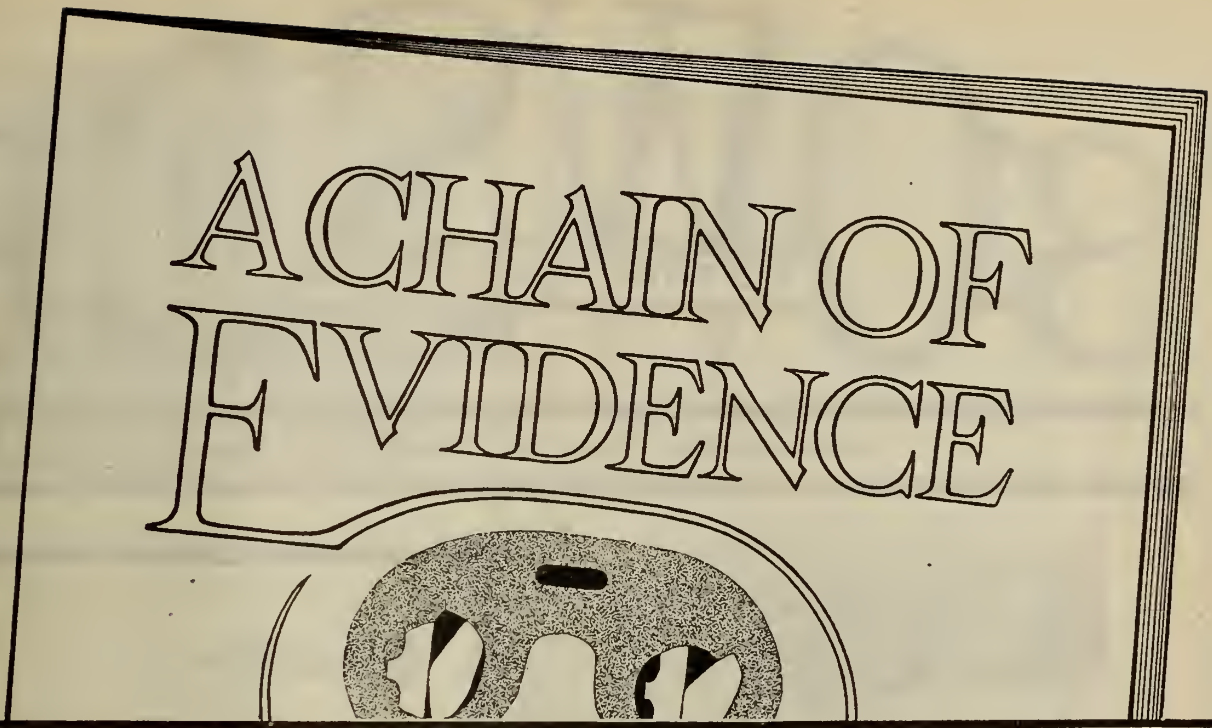
**Good things for
the POWER PLANT**



Write us today for a FREE COPY

If you use power at all, you will be interested in our Publication, No. 15

Small Power Drives

OUR business has been built up largely on the foundation of service rendered by "small power drives." With 1,500,000 horsepower of MORSE "Rocker-Joint" Silent Chains now in use, imagine for a moment the thousands of different applications. They have entered practically every power-using industry, from A to Z, and everywhere have given the same uniform economical service, meeting our own expectations and satisfying our customers.

Get a copy of this bulletin and look around your shop or factory and see where a more quiet drive would be welcome, where a more efficient drive would add considerably to your production, or where a little space could be more advantageously utilized. Then think how well a chain drive,—"MORSE, of Course,"—will meet your requirements.

MORSE CHAIN COMPANY, ITHACA, N. Y.

MORSE CHAIN CO., Ithaca, N. Y.
Please send me a free copy of your new publication, Number 15.
A CHAIN OF EVIDENCE, devoted exclusively to "Small Power Drives."

NAME__________
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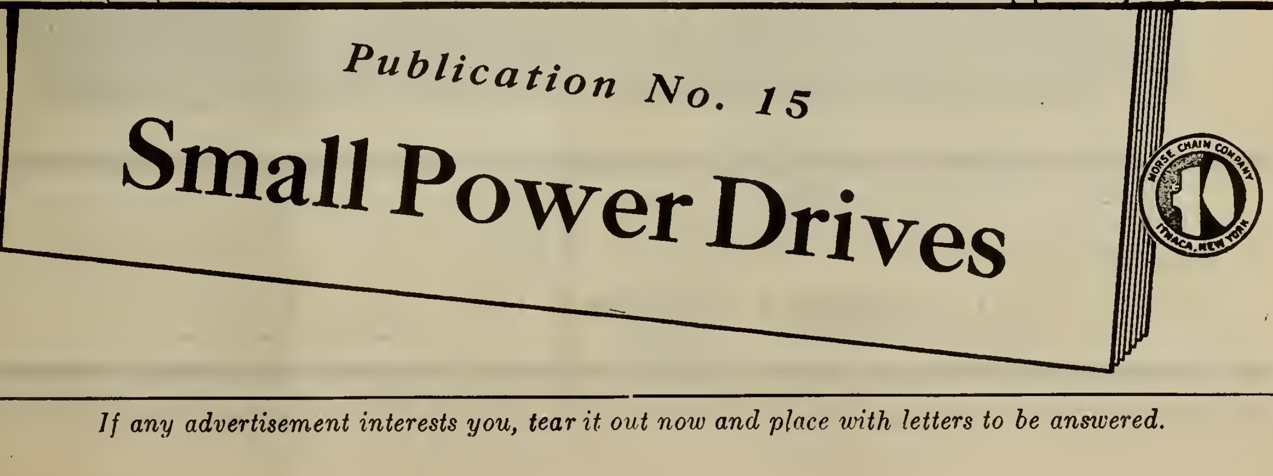
ADDRESS__________

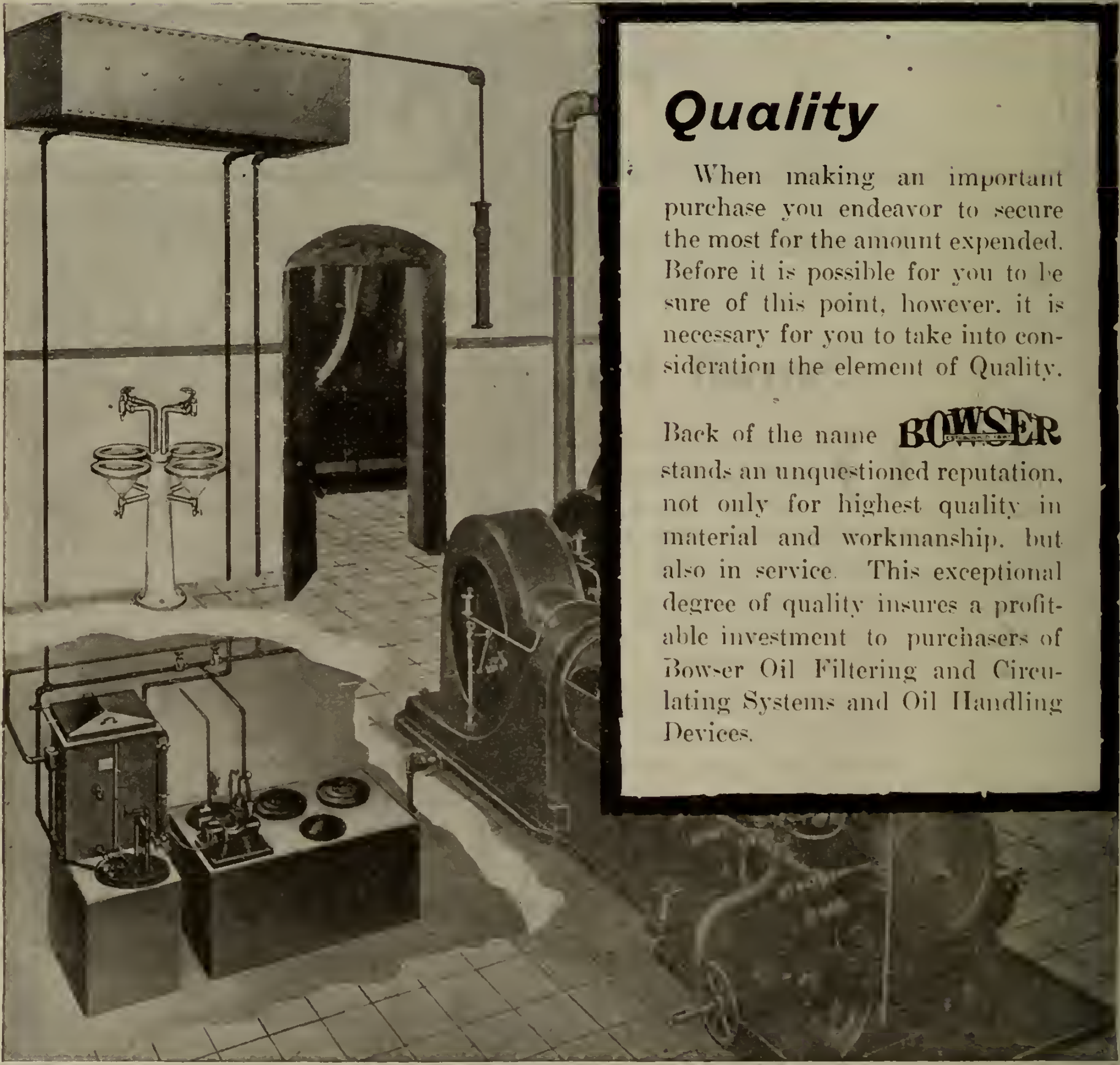
POWER HOUSE, DEC. 1916.



BOWSER

ESTABLISHED 1885

Equipment for Every Oil Handling Condition



Quality

When making an important purchase you endeavor to secure the most for the amount expended. Before it is possible for you to be sure of this point, however, it is necessary for you to take into consideration the element of Quality.

Back of the name BOWSER stands an unquestioned reputation, not only for highest quality in material and workmanship, but also in service. This exceptional degree of quality insures a profitable investment to purchasers of Bowser Oil Filtering and Circulating Systems and Oil Handling Devices.

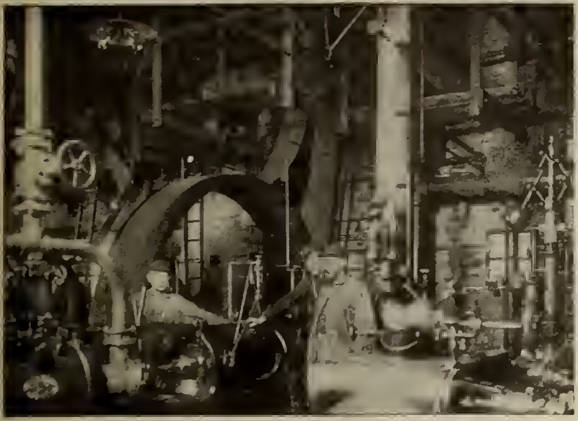
The above illustration shows a representative installation of the Bowser 2F Oil Filtering and Circulating System—a Gravity System especially designed for reciprocating engines and similar machinery where the engine room has a basement.

The Bowser line comprises Oil Filtering and Circulating Systems for every power house requirement—types and capacities to meet all operating conditions.

May we help you solve your oil handling problems? An inquiry incurs no obligations.

S. F. BOWSER & COMPANY, Inc., Toronto, Ontario

Sales Offices in All Centers **Representatives Everywhere**



You Wouldn't Think This Cling-Surface-Treated Belt was Pulling 300 H.P.

This 16-in. Gandy belt, pulleys, 12 ft. and 30 in., with 16 feet between centers, is running at 2,340 ft. per min. and is pulling 300 h.p., yet under Cling-Surface treatment and the big sag shown *there is no slip.*

Besides giving this belt better pulling surface and more effective contact area on both pulleys, Cling-Surface also waterproofs the fabric, makes and keeps it pliable and practically eliminates maintenance attention and expense.

Your initial order for at least a few pounds of Cling-Surface should go out *to-day* if you appreciate *real* belt service at low cost. Ask, at least, for literature.

We quote f.o.b. Toronto.

Cling-Surface
the life preserver for belts

Cling-Surface Co.
1057 Niagara Street
Buffalo NY

I am interested in Cling-Surface and your trial order proposition.

Name .... Position ....

Firm ....

Street ....

City .... Province ....

93

EFFICIENT AND ECONOMICAL LUBRICATION

Albany Grease is efficient because it will lubricate perfectly at all times any kind of machinery and line shafting. It is economical because it stays where it is put, does not run or leak away.

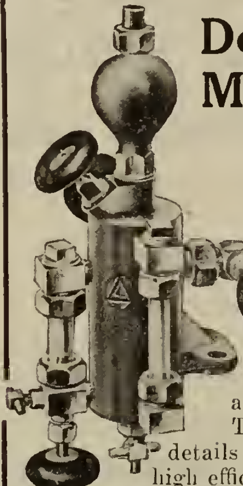
ALBANY GREASE

will only flow enough to give perfect lubrication, no more. When the machine is not in operation, Albany Grease does not flow. Write for a quantity of Albany Grease and a cup to test. No charge

Your dealer sells Albany Grease ; if not, order direct

Albany Lubricating Co.
ADAM COOK'S SONS, Props.
708-10 Washington St., New York
Established 1868

Detroit Lubricators Meet Demands of Every Kind of Service



They are scientifically designed in a sufficient variety of styles and kinds to properly lubricate the valves and cylinders of all types of steam engines, steam pumps, gas engines, air compressors, etc.

The greatest care is given to all details of manufacture to insure uniformly high efficiency. They provide constant, evenly regulated and economical lubrication. There is nothing of the "hit or miss" about them. Send for our catalog L1 to-day. It contains much valuable information upon lubricating devices and will be sent upon request.

THEIR efficiency holds over half the world's trade.

Makers of the Stewart Carburetors.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD.
WALKERVILLE, ONT.

THE
LINDE CANADIAN REFRIGERATION
COMPANY, LIMITED

Montreal, 37 St. Peter Street

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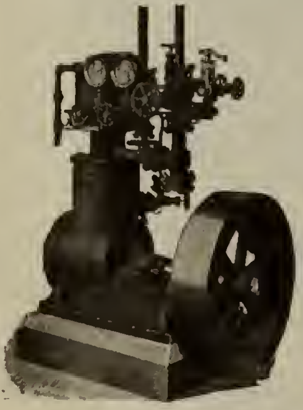
Makers of Quality Machinery in Canada since 1896



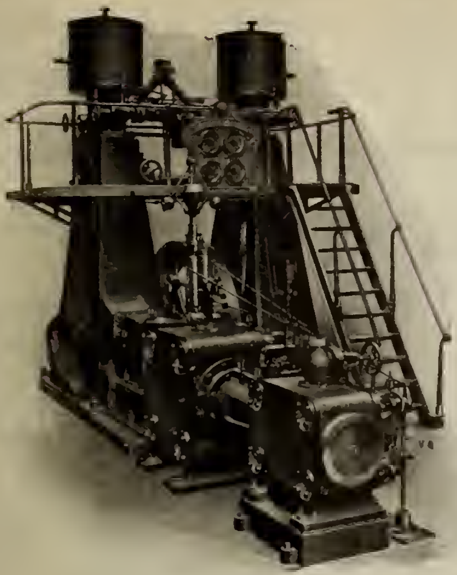
Ice-making and Refrigerating Machinery

Built in any capacity that you desire. HORIZONTAL OR VERTICAL

Our SMALL MACHINES have the same "regularity of Operation," "Reliability" and "Efficiency" as our large ones. AMMONIA FITTINGS, CONDENSERS, BRINE COOLERS, ETC.

Corliss Engines *Special Machinery*

THE VILTER MANUFACTURING COMPANY
242 Beecher Street, MILWAUKEE, Wis. *Chicago Office:* 731 Monadno Building



Why not operate your Plant with the highest efficiency and economy?

Write us advising what you have been doing and what additions you have contemplated.

Our Engineering corps will advise you impartially the best type of Plant for you to install and what you will need to reach the highest efficiency and lowest costs.

Get our new Fitting Catalog.

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

Canadian Representatives:
THE FRICK ICE AND REFRIGERATION COMPANY, 357 St. Catherine Street West, Montreal

DOORS

For Cold Storage and Freezer Purposes Either Standard or Fireproof

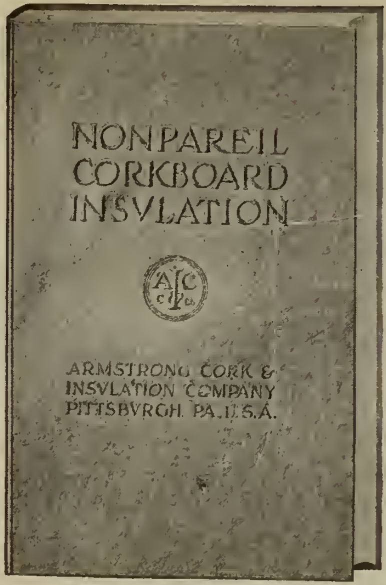
JAMISON'S "JONES" and "NOEQUAL" doors are SUPERIOR because:

1st—Only the best materials are used in their construction.
2nd—We use heavier materials. Result: Longer life and increased efficiency.
3rd—Our doors are built with double and triple seals of contact—others have but one.
4th—Our Automatic Self-Tightening Fastener is the only truly AUTOMATIC and SELF-TIGHTENING Fastener on the market.
5th—Our ADJUSTABLE SPRING Hinges mean the door is always properly seated in the frame, making sagging impossible.

Write for General Catalog No. 7, illustrating and describing both "Jones" and "Noequal" doors, windows, ice doors and chutes, etc.

Jamison Cold Storage Door Company

Formerly Jones Cold Store Door Co. **HAGERSTOWN, MD., U.S.A.**



NONPAREIL
CORKBOARD
INSVLATION

ACIC°

ARMSTRONG CORK &
INSVLATION COMPANY
PITTSBVRGH. PA. U.S.A.

Yours for the asking

A copy of the book and a sample of Nonpareil Corkboard will be sent, free of charge, to anyone interested.

What is continuous wall insulation?

How are solid corkboard partitions constructed?

What is the most satisfactory cold storage room floor?

Why should columns in cold storage rooms be insulated?

What is the cheapest way to apply insulation to concrete ceilings?

These and many other questions of vital interest to the purchaser of cold storage insulation are fully explained in the new, 152-page, bound book entitled

Nonpareil Corkboard Insulation

For all Cold Storage Rooms

This book is more than just a trade catalogue. It is a comprehensive treatise on cold storage insulation, yet it is written so that it is easily understood by the layman as well as the engineer.

Much of the information given has never appeared before in printed form and will be of value to all those interested in or connected with cold storage plants.

Armstrong Cork & Insulation Co., Ltd., 504 McGill Bldg.
Montreal, Que.

Also manufacturers of Nonpareil Cork Covering for cold pipes, Nonpareil High Pressure Covering for steam lines, feed water heaters, etc., and Nonpareil Insulating Brick for boiler settings.

YORK

NATURALLY we are enthusiastic about YORK Refrigerating Equipment. We know how good it is in Design, Material and Workmanship—and what it will do.

This knowledge is rapidly spreading over the entire field, as we are constantly adding new patrons as a result of the excellent performance of YORK Plants in actual service.

Those who contemplate the use of Mechanical Refrigeration for any purpose, our Engineering Department can help in the preliminary steps.

The complete YORK line offers greater value for a given investment than can be obtained elsewhere.

With YORK SERVICE back of a YORK Plant, the Owner can feel sure that he has safeguarded his every interest.

Therefore a YORK PLANT *is the logical one to buy.*

THINK IT OVER

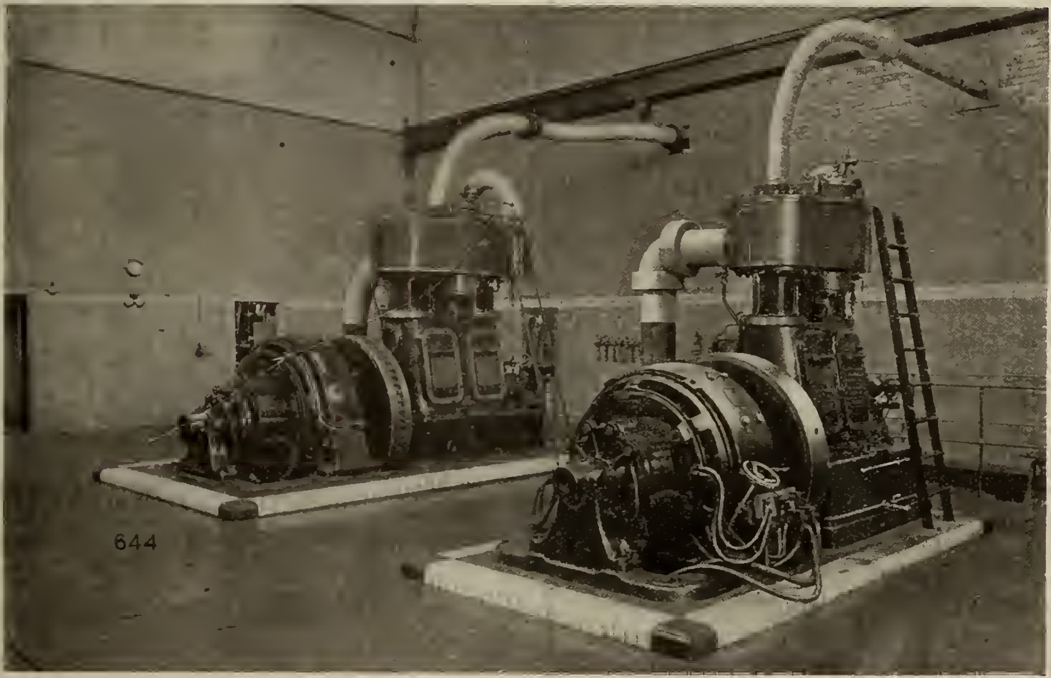
Represented in the Dominion by
Canadian Ice Machine Company
MONTREAL - - - 626 Coristine Building
TORONTO - - - - 82 Chestnut Street
WINNIPEG - - - - 85 Lombard Street

York Manufacturing Company

(Ice-Making and Refrigerating Machinery exclusively)

YORK, PA., U. S. A.

BELLISS & MORCOM, LTD.
Engines and Air Compressors



Belliss & Morcom Engines installed in McGill University Power House
Total Horse Power, 1010 B.H.P.

We have for immediate delivery several Engine Generator Sets. Write for Particulars.

Send Us Your Enquiries For

- Steam Engines
- Gas Engines
- Oil Engines
- Diesel Engines
- Steam Turbines
- Air Compressors
- Condensing Plant
- Centrifugal Pumps
- Boiler Feed Pumps
- Water Wheels
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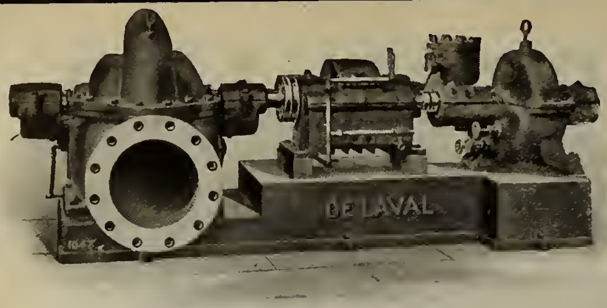
- Refuse Destructors
- Activated Sludge Sewage Disposal Plants

Complete Power Plants Designed and Erected.

LAURIE & LAMB

Engineers

211 Board of Trade Bldg. :-: :-: MONTREAL



De Laval Geared Turbine-driven Centrifugal Condenser Circulating Pump: 5,500 Gal. per Min.: 25 Ft. Head.

EFFICIENT CONDENSER CIRCULATING PUMPS

Handling large volumes of water against low heads at good efficiency requires a large pump running at slow speed. As only comparatively small power is needed, the driving turbine should run at a high speed.

By using the De Laval Double-helical Speed-reducing Gear, both conditions are secured and the maximum duty developed.

The turbine can be adapted to any steam conditions, as receiving boiler steam and exhausting to feed heater or receiving the exhaust of other auxiliaries and exhausting to condenser.

The unit is simple and reliable, all parts being readily accessible upon lifting the casing covers and without disconnecting piping. Parts subject to wear, such as labyrinth wearing rings, bearings, propellers, etc., are built on an interchangeable basis to limit gages, and can be renewed at small expense of time and money. Duplicates ordered from the shop can be put in place without requiring fitting.

The capacity and efficiency of each unit is guaranteed and a thorough test is made at the shop before shipment.

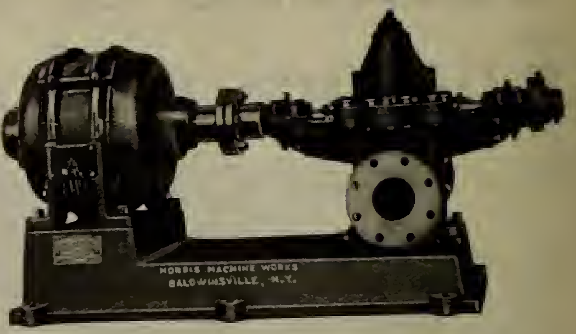
State requirements, i.e., steam and exhaust pressures, horse power, volume of water to be pumped, and head and further particulars, together with our Publication B. 61, will be sent.

DE LAVAL STEAM TURBINE COMPANY

TURBINE EQUIPMENT CO., LIMITED, Canadian Pacific Building, Canada.
THE E. LAURIE CO., 243 Bleury Street, MONTREAL, Que.

255

Morris Pumps



The horizontal shaft double suction pump illustrated above was designed to meet the demand for a high efficiency pump. It is also built multi-stage in sizes from 2" to 20" discharge.

Our 126 PAGE MORRIS BOOK is free. Better send for it—To-day.

Morris Machine Works Baldwinsville, N.Y., U.S.A.

Builders of Centrifugal Pumps, Hydraulic Dredges, Steam Engines

Canadian Sales Agents:
Storey Pump & Equipment Co., Toronto, Can.

Kerr Economy Buckets Last For Years

BUCKET erosion is almost an unknown quantity in the "Kerr Economy" turbine because the pressure drop from stage to stage is but a fraction of the total drop from boiler pressure — and the resulting steam velocities are low. Bulletin 55 explains more about this turbine—**sent free on request.**

Kerr Turbine Co., Wellsville, N.Y.

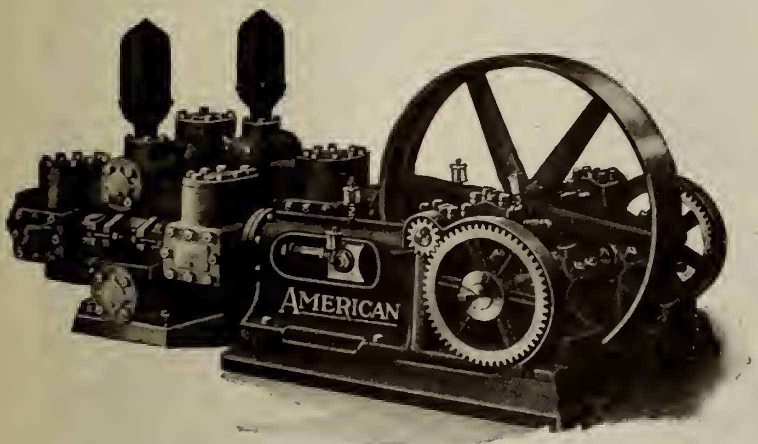
OFFICES IN ALL LARGE CITIES

MARSH and AMERICAN

Pumping Machinery. Steam and Power Driven

The world has used and endorsed over 130,000 Marsh and American Pumps. Twenty-seven years of pump manufacture have proved our ability and perfected our facilities. Marsh and American Pumps are 100 per cent. correct—from the selection of raw material and accuracy of design to the actual pumping service, day in and day out, year after year. They ask no apologies and never have to explain away any error in service or failure in efficiency.

Investigate. Ask for our 250-page catalog illustrating and describing the line. Your pumping problems will be answered fully and satisfactorily through this investigation. This catalog will be sent by return mail in answer to your inquiry. Your copy is awaiting your prompt request.



American Duplex Belt-Driven Boiler Feed Pump. Outside Packed Plunger Pattern.

AMERICAN STEAM PUMP COMPANY

BATTLE CREEK, MICH.

CANADIAN AGENTS:

A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
London Engine Supplies Co., London, Ont.
Stuart Machinery Co., Winnipeg.
Mechanics' Supply Co., Quebec, Que.
Gorman, Clancy & Grindley, Limited, Edmonton and Calgary.
Taylor Engineering Co., Ltd., Vancouver, B.C.

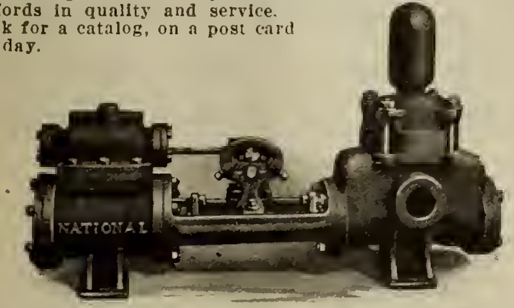
The Balanced Piston Valve

Simplifies the steam chest construction, elminates the slide valves, and gives better steam economy. The valve is fitted with snap rings to provide for wear.

NATIONAL STEAM PUMPS

National Pumps are made from the best materials under most careful construction, and embody the latest and best designs known to modern engineering.

THERE'S a National Pump to fill your every requirement and we guarantee every one to be the best the market affords in quality and service.
Ask for a catalog, on a post card to-day.



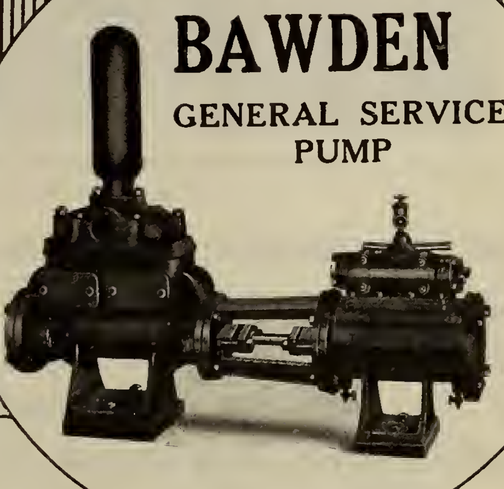
"NATIONAL" Boiler Feed Pump

National Steam Pump Co.
Upper Sandusky, Ohio

BAWDEN NEVER SHORT STROKE PUMPS

BAWDEN

GENERAL SERVICE PUMP



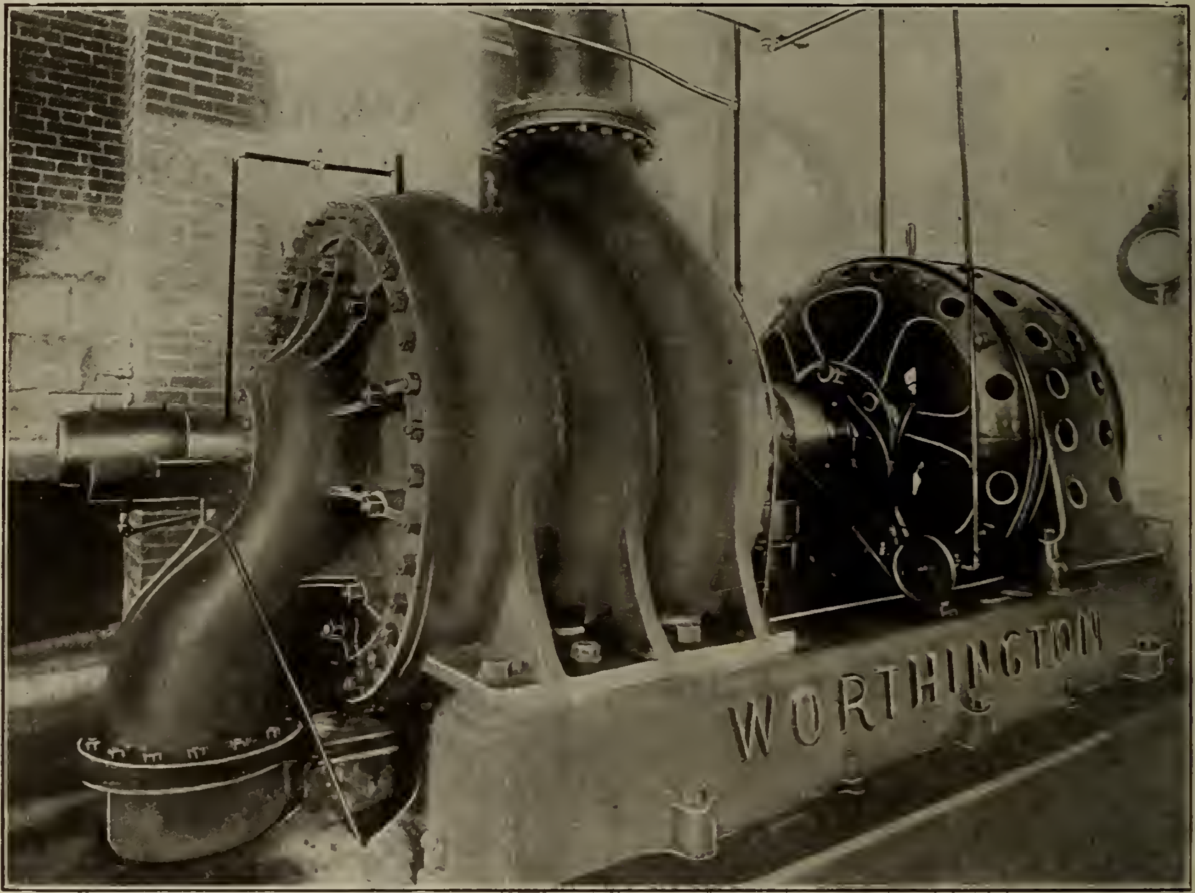
NO Tappets. NO External Valve Gear Levers or Springs. NO Internal Tubes or Stuffing Glands.
Construction is of very best throughout.
The Steam Cylinders are designed to withstand modern pressures. They are fitted with cast iron block pistons; self-adjusting cast iron rings and steel rods. Water cylinders are of suitable strength for pressures not exceeding 100 lbs. per square inch.
Drop a card for full particulars.

THE BAWDEN MACHINE CO., LIMITED
133 STERLING ROAD, TORONTO, CANADA

THE JOHN McDOUGALL CALEDONIAN IRON WORKS CO., Limited

Manufacturers of Boilers, Castings, Condensers, Elevators, Engines, Filters, Forgings, Hydraulic Machinery, Pumps — centrifugal and reciprocating, Steam Turbines, Tanks, Water Wheels, Water Works Plants

Works : Seigneurs and William Streets, MONTREAL



5,000,000 gallons daily—Montreal Water Works—Driven by 400 H.P. Induction Motor.

Our Engineers have spent many years developing Centrifugal Pumps and we are now able to offer you perfected designs in any size pump from inch and a half and up for any service you may desire, and to be driven either with motor, engine or belt.

Write us for Engineering information, or prices, any time.

Sole Canadian Agents for H. R. Worthington Co.

Keeping in Stock at Montreal a large assortment
of their Boiler, Feed and General Service Pumps

The Publisher's Page

TORONTO December, 1916

Selling the Buyer

(No. 2 of a Series of Short Articles)

Advertising Reduces Selling Expense

SINCE selling consists in great part of educating the buyer and since the process can be accomplished through advertising, it is reasonable to consider advertising a potent factor in your sales organization. Advertising can be made to reduce the time required by a salesman to make a sale. It is intended to supplement the personal salesman, not supplant him. It can be made to perform the very necessary work of education which otherwise would be tedious and expensive. It insures more respectful attention for personal letters, for catalogues and for other literature, as well as for salesmen.

INFLUENCING THE SILENT VOTE

There is an important phase to the usefulness of the technical journal, one which should be carefully considered, i.e., its influence upon the apparently silent, though nevertheless important, vote.

In every plant there are men whose advice is sought by the men who have the actual buying power. Upon their recommendations a sale is frequently made or denied. The salesman may be told to call again a little later or to wait while the buyer consults "someone" else. This is the crucial time for the salesman, but the man who represents a well-advertised house and line, can afford to await results more confidently than the man whose line has not been heralded for months in advance.

The value and importance of reaching and lining up the silent vote cannot be over-estimated. He is indeed a wise manufacturer who will endeavor to reach the greatest possible number of buyers, and buying influences.

When thousands of dollars have been expended in plant and equipment, when a reliable product is being manufactured and when an expensive sales force is being employed, then everything possible should be done to insure maximum results.

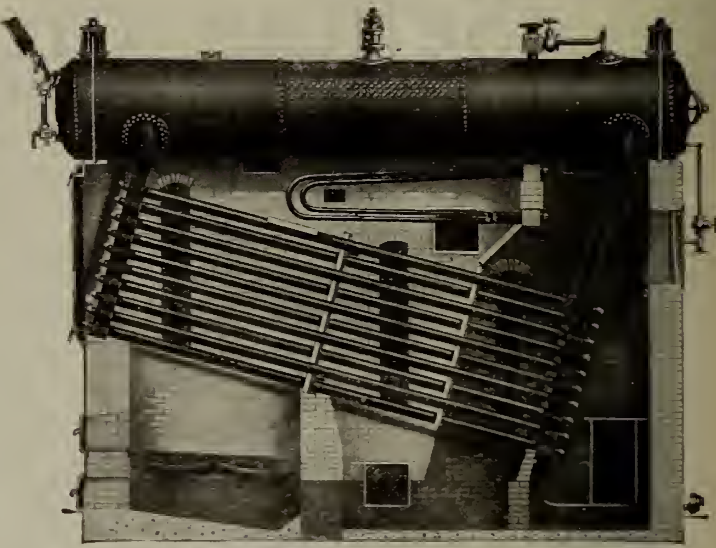
THE POWER HOUSE
143-153 University Avenue - Toronto

Make Your Plant Independent by Producing Your Own Power---Get a Continuous Service

It is very annoying, to say the least, to have your plant standing idle when you are probably in the midst of some most important and urgent operations.

Unless you have your own Power plant you are never sure of your service; you are depending upon something over which you have absolutely no control.

Produce your own Power. It is far more satisfactory, and besides it is nearly always cheaper.



Showing a Sectional View of the G. & McC. Co. Type "B" Sectional Water-Tube Boiler.

G. & McC. Co.
POWER EQUIPMENT

is the solution to your Power troubles. Our Engines, Boilers, Heaters, Pumps, etc., are designed and built with one object in view, namely: Quality and satisfied users. Among our various types there is sure to be one that will meet your own particular requirements.

IMPORTANT

All parts of G. & McC. Co. Sectional Water-Tube Boilers that are subjected to Steam Pressure are

MADE OF FORGED STEEL

Catalogs, Plans, Engineering Advice, etc., will be cheerfully furnished upon request.

The GOLDIE & McCULLOCH COMPANY, Limited

HEAD OFFICE AND WORKS:
GALT, ONTARIO, CANADA

TORONTO OFFICE:
Suite 1101-2 Traders Bank Bldg.

WESTERN BRANCH:
248 McDermott Ave., Winnipeg, Man.

BRITISH COLUMBIA AGENTS:
Robt. Hamilton & Co., Vancouver, B.C.

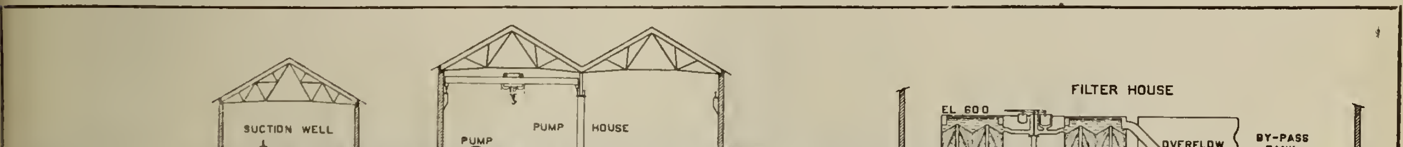
QUEBEC AGENTS: Ross & Greig, 412 St James St., Montreal, Que.

60 Million Gallon Drifting Sand Filtration Plant City of Toronto Ont.

Staff Article

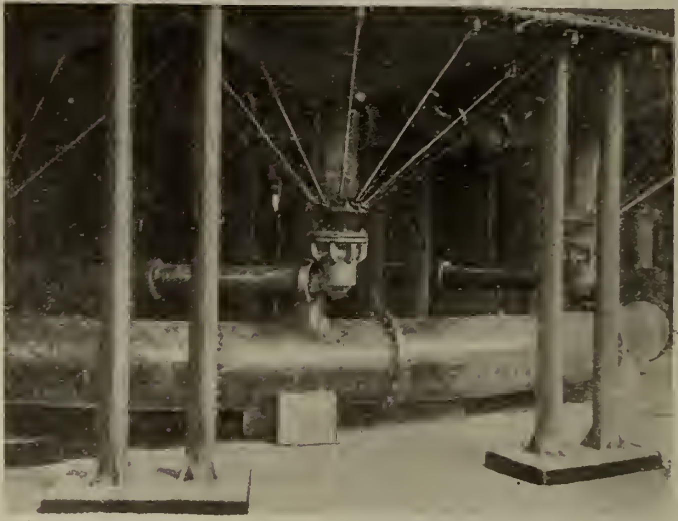
A plant of the nature here described and illustrated embodies in its make-up and result accomplishment features of interest alike for the mechanic and private citizen, no matter their community or national location; the necessity for pure water, either for consumption alone or as a food constituent being generally recognized as a public health essential.

THE new mechanical filtration plant at Toronto Island, which has been under construction since the fall of 1914, is now practically completed, and some filtered water is already being delivered to the city. An additional supply of pure water for the city of Toronto became imperative owing to the rapid increase in population, the slow sand plant installed being altogether too small for the requirements. Owing to the condition of the water in Lake Ontario, some form of filtration is necessary. After considerable investigation the city authorities decided that for the new plant mechanical filtration was more suited to local conditions than the slow sand system. Specifications and plans were accordingly prepared under the supervision of Works Commissioner Harris, and tenders on same were received in January, 1914. In June of the same year the tender submitted by the John verMehr Engineering Co., of London, England and Toronto, as engineers, and William Cowlin & Son (Canada), Ltd., of Bristol, England, and Toronto, as contractors, was accepted for a Ransome mechanical type drifting sand filter, with a capacity of 60,000,000 Imperial gallons per 24 hours, and at a contract price of $1,066.282.

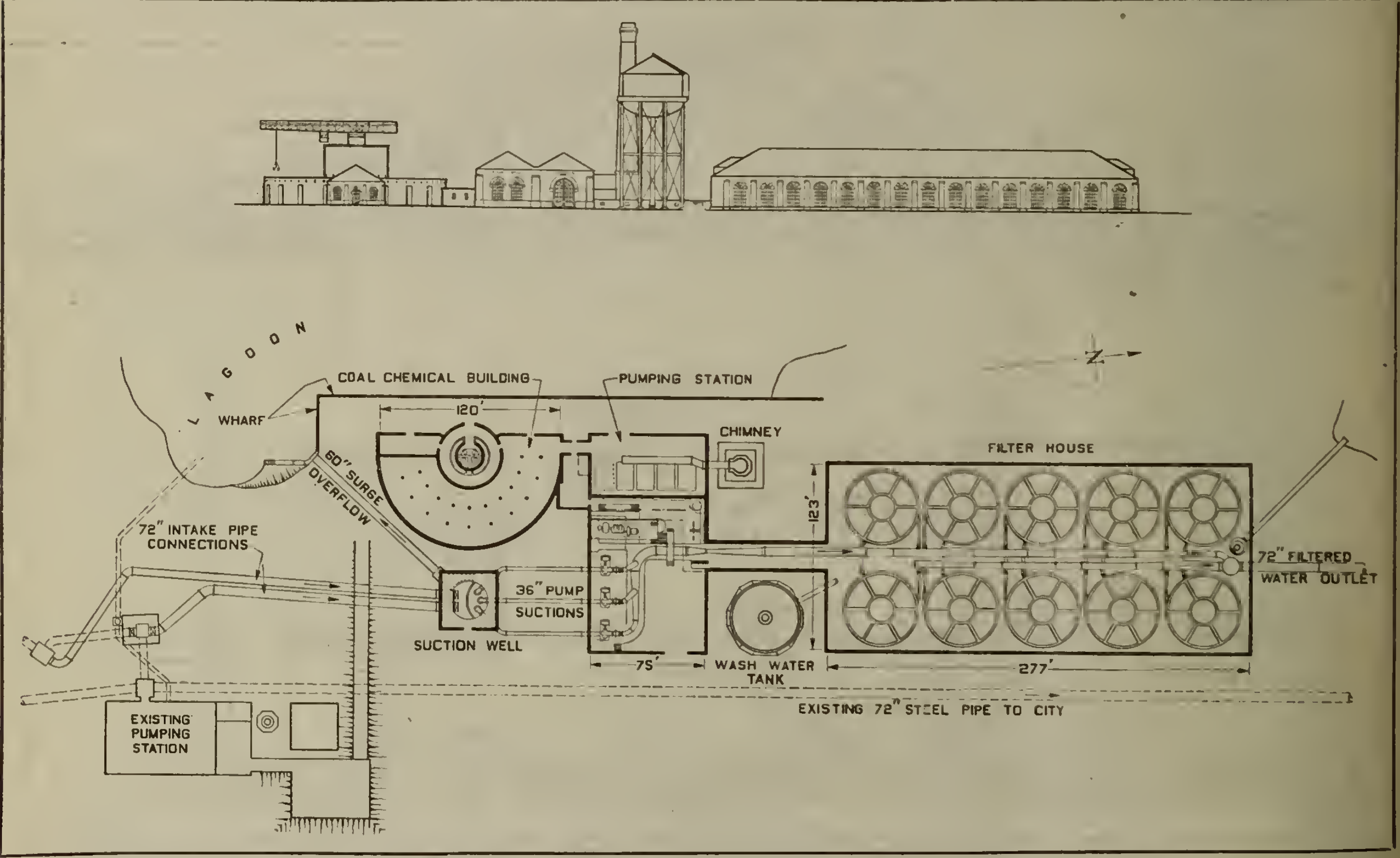


UPPER VIEW SHOWS LONGITUDINAL SECTION THROUGH PLANT, AND LOWER VIEW A SECTION THROUGH SINGLE FILTER.

When the city of Toronto contemplated installing an additional filtration plant, the John verMehr Engineering Co. solicited consideration of their system. The request being granted, the company proceeded to erect a demonstration plant on Ellis avenue, West Toronto, for the purpose of proving the efficiency of their system and its suitability to local conditions. The plant was constructed during the spring of 1913 and turned over to the city for the official test on May 21. This continued until June 27, 1913, operation being closely watched for a period of one year. The results of the test were highly satisfactory, and were the subject of a report issued by Drs. Geo. G. Nasmith and Fred. Adams, of the Department of Public Health, Toronto. The plant at the Island was designed by the John ver Mehr Engineering Co., of which William Gore, M.Inst. C.E., is the consulting engineer, and William Storrie, A.M.Inst.C.E., the chief engineer. It is the largest drifting sand filtration plant yet installed and the largest filter plant of any type in the British Empire. The construction and operation features have aroused considerable interest among engineers in both Canada and the United States. The company has constructed smaller plants of the type in Great Britain, Brazil, Jamaica, etc.; in addition, they have supplied portable units for use at the various Allied battle fronts.



SAND WASHER UNDERNEATH EACH FILTER. THERE BEING 30 SAND WASHERS TO EACH UNIT.



UPPER VIEW SHOWS EASTERN ELEVATION OF PLANT, AND LOWER VIEW THE GENERAL ARRANGEMENT PLAN.

Drifting Sand System of Filtration

The plant as already stated has a contract capacity of 60,000,000 Imperial gallons in 24 hours, but must be able to operate at a rate of 72,000,000 Imperial gallons for 10 hours. An important feature of the drifting sand system is its ability to filter unusually turbid water without excessive clogging of the filters, thus obviating the necessity of frequent shutdowns to wash the whole bed of filtering material, which is done without using large settling tanks and coagulating basins. The coagulant, sulphate of alumina, is introduced in the raw water in the suction well. This water is then pumped to the filters. The sand bed in the filters is composed of fine sand 9 feet deep, laid on a bed of gravel, 9 ins. deep. The action of the influent causes the upper part of the sand bed to drift across the water being filtered, the bulk of the impurities being swept out, together with a part of the drifting sand, the latter being washed and returned to the bed by the circulation of the water. The lower portion of the sand bed which remains stationary removes the remaining impurities in the water. The stationary sand bed is washed by reversing the flow of filtered water at long intervals.

The raw water enters the filter through a standpipe (see cross section of filter), in the centre of the unit, after passing through a sand washer at the bottom, and delivers above the sand at the top and also through a vertical by-pass. The sandwasher is an important feature of the system. The drifting sand passes over the top of the stationary sand bed down to a system of outlets or extractors, and thence by pipes to the sand washer. Here the sand falls to the bottom through a current of raw water and is picked up by an inductor. The dirty water passes upward and out at the top of the washer. The sand extractors are of such form that the sand is kept out of the piping system except when the inductor is in full operation. Within the sand washer the raw water pipe is in the form of a venturi tube, and the drifting sand collected and washed in the washer is inducted into the raw water at the throat of the venturi tube. This sand passes up the standpipe with the water and is delivered, with it, above the top of the sand bed, forming a cone which continuously drifts away and is continuously being replaced. Under the gravel bed is the filtered water collecting system.

VIEW OF FILTER UNIT IN OPERATION, SHOWING RAW WATER COMING UP THROUGH VARIOUS INLETS. THE OPERATING TABLE, VENTURIMETER, AND LOSS-OF-HEAD GAUGE ARE TO BE SEEN IN THE FOREGROUND.

Plant Layout

The area occupied by the entire plant is nearly $2\frac{1}{2}$ acres. At the lake end of the plant is the suction well, connected to chambers near the lake by two 72-in. diameter steel pipes, through which the water flows by gravity to the well. To the west is the coal and chemical store, a concrete structure located near the wharf so that the materials coming over on scows can be handled with facility. Next, to the north, is the boiler house, with the pumping station adjoining. A chimney is built to the north of the boiler house, and the wash water tank is situated between the pumping station and filter house. The chimney was built by the Custodis Canadian Chimney Co., Toronto, and is 122 feet high above boiler grate bars, and 7 ft. inside diameter at the top. It is constructed of buff pressed brick outside, and "Custodis" perforated radial brick inside, with a firebrick lining 40 feet up. The wash water tank was built by the Canadian-Chicago Bridge & Iron Works, Bridgeburg, Ont. The tank is of steel and has a capacity of 200,000 Imperial gallons. Its bottom is 60 feet above the ground and 45 feet above the top of the filters. The filter house is on the north side of the plant and is connected to the pumping station by a tunnel in which is also a 72-in. venturi meter.

The sand for the filters was obtained from pits on the mainland. The sand was taken in cars to the sidings at the foot of Spadina avenue and towed across on scows to the Island, being afterwards prepared at the site. All coal required is taken over the same way. During the construction of the plant the contractors had their own carpenters, blacksmiths, and machine shops. Philip J. Duff has been resident engineer in charge of the plant since the work started. Considerable care had to be exercised and special precautions adopted when excavating and building the foundations owing to the water-logged condition of the land. The buildings, with the exception of the coal and chemical storage, have reinforced concrete foundations, with concrete substructures carried up to a height of one foot below the finished ground level. The superstructures of the buildings are of buff pressed brick, and on the steel frame work forming the roof is placed boarding with red Spanish tile on top. The window frames are of pressed steel sash, fitted with wire glass. The floor and substructure of the filter house are built in sections with joints to allow for expansion or contraction.

Suction Well

The suction well building is 40 ft. square and the suction well is 24 ft. diameter and 25 ft. deep. The water comes from the lake into two chambers near the lake front and flows by gravity through two 72-in. diameter steel pipes, one from each chamber to the suction well. At the end of each pipe in the well is a 72-in. hydraulically operated gate valve supplied by Glenfield & Kennedy, Kilmarnock, Scotland. The valves are operated at a pressure of 700 lbs. per sq. inch from hydraulic pumps and accumulator located in the pumping station. The valves open the full 6 ft. in $2\frac{1}{2}$ minutes. The suction well is used as a screen chamber from which the water is taken by three 36-in. pipes to the pumps. There are six sets, being 3 screens to each set, of fine mesh copper in duplicate, so that one set can be taken out for cleaning while the other set is in

INTERIOR VIEW OF PUMPING STATION, SHOWING THREE 36-MILLION GALLON "DE LAVAL" PUMPS.

operation. The suction well has a surge overflow in the event of any sudden failure of the Hydro power. There is a Builders' Iron Foundry indicating instrument for indicating the water elevation at all periods. The building is steam heated and there is also a 1-ton crane provided for lifting the screens. The coagulant is introduced to the water in the well, coming through duplicate pipes from the chemical building.

WILLIAM STORRIE, A.M. INST. C.E.,
Chief Engineer and Director, John verMehr Engineering Co.

Chemical and Coal Storage

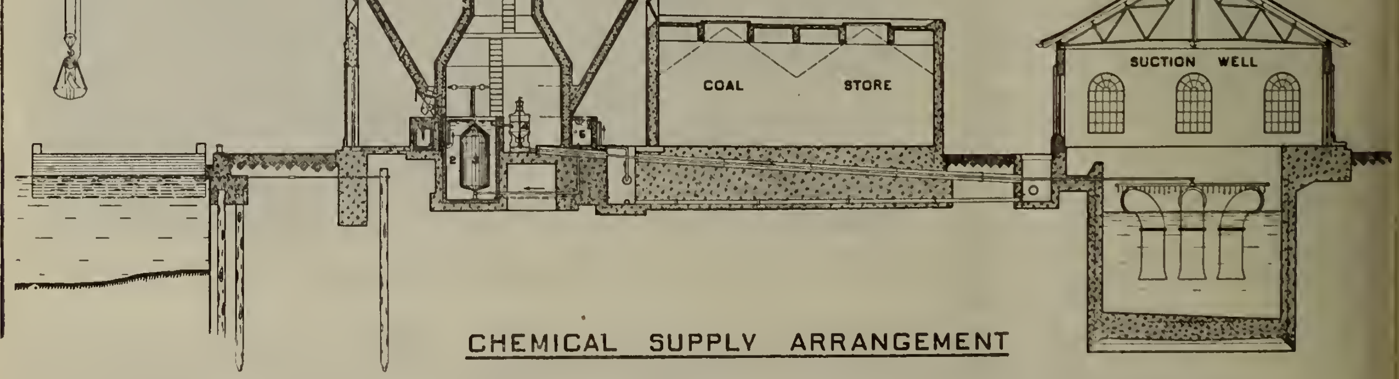
The building comprising the chemical and coal storage is constructed of reinforced concrete. The chemical building is circular, being 40 feet diameter, the upper part carrying a horizontal 4-ton crane with 60 ft. reach for unloading scows at the wharf. The coal storage is built around the chemical buildings except at the front, which is straight. The coal storage has a capacity of 1,500 tons. The chemical building will hold about 800 tons of sulphate of alumina or alum, as it is more generally called. Around the storage bin are a number of doors through which the alum is fed down to a tray at mid-level in the dissolving channel maintained full of water. The solution is fed from this channel into a dilution tank in which it is automatically diluted down to the standard 5 per cent. by an arrangement similar to a hydrometer. From the tank the solution is fed into a measuring tank controlled by the 72-in. venturi raw water meter in the pumping station through a combined electric and hydraulic relay. From the bottom of the measuring tank the solution gravitates through lead pipes to the suction well and is there distributed throughout the raw water.

In this apparatus, which is in duplicate, the annular dissolving channel tank is kept full of filtered water by a float valve. From the water tank the water flows freely to the dissolving tank and, after dissolving, the alum passes through a valve at the top of the hydrometer. At the same time the water also comes from the water tank to a valve at the bottom of the hydrometer. The hydrometer is poised in the solution between the two valves. Any vertical movement of the hydrometer opens one valve and closes the other. Thus it will let in strong solutions at the top and water at the bottom until the balance is obtained, at which the hydrometer just floats in a solution containing 5 per cent. of aluminum sulphate.

Filter House and Filters

The filter house is 277 ft. long by 123 ft. wide. It contains ten steel filter tanks, arranged in two rows, each tank being 50 feet diameter and 14 ft. deep. Between the two rows are the mains for the raw water, filtered water, and waste water. These mains are connected with each filter by cast iron pipes equipped with hydraulically operated gate valves.

WILLIAM GORE, M. INST. C.E.,
Consulting and Civil Engineer to John verMehr Engineering Co.



CHEMICAL SUPPLY ARRANGEMENT

The operating gallery extends the full length of the building in the centre and at the same level as the top of the filters. The gallery has stairways at each end. On the gallery are ten operating tables, five on each side, or one for each filter. The tables are made of Cecilian marble and have on the top handwheels for operating the small valves under the table, which work the hydraulically operated gate valves that control the filters. In connection with each handwheel there is a gauge for indicating the amount of opening of each valve. Behind the table are situated a loss-of-head gauge, and a venturi water meter, registering the amount of filtered water. On the west side of the space between the two rows of filters is the 72-inch raw water pipe while on the other side is a corresponding pipe for filtered water, delivering into the inspection tank at the end of the building. Above these pipes are situated two 36-in. cast iron pipes, one above the other. The lower pipe takes water after backwashing from the overflow gutters of the filters, while the upper pipe is for back wash water and is connected to the wash water tank. There are, in this building, 50 Glenfield & Kennedy hydraulically operated valves ranging from 6 ins. to 24 in. diameter.

Filter Tanks

The filter tanks are constructed of steel plate supported by cast iron columns. In the centre of each tank is a space 16 feet 8 in. in diameter, in which is located a 16 in. diameter by-pass with a relief valve. At the top of the filter are arranged gutters for carrying off the wash water during the cleaning operation. Each tank contains about 600 cubic yards of sand and has 30 sand cones or units with a 6 in. standpipe up the centre of each cone. For about 3 feet above the bottom of the tank these units are separated by spaces formed with steel plates and containing the extractors. On the bottom of the tank is the filtered water underdrain system consisting of $1\frac{1}{2}$ in. perforated sherardized pipes laid on concrete and connected to a collector. Gravel 9 in. deep is placed on the pipes in three layers, each a different grade. The filter sand is placed on top of the gravel to a depth of 9 feet. When the filters are operating, the stationary sand cones have a slope of 60 degrees and the drifting sand cones 30 degrees to the horizontal. The cones are formed by the action of the water and drifting sand passing down through the extractors to the sand washer and up to the standpipe, the sand being deposited around the pipe at the angle of repose. The surface of the stationary sand collects the deposit in the water as it passes through to the underdrain system.

INTERIOR VIEW OF PUMPING STATION, SHOWING AUXILIARY PUMPING UNITS AND SWITCHBOARD PLATFORM.

When in operation, the coagulated raw water passes from the raw water main and enters the filter partly through the sand washer and up the standpipe or through the by-pass controlled by a relief valve. From the top of the filter it passes in turn through the drifting sand, stationary sand and gravel, to the collecting system, where it flows away through the filtered water main to the inspection tank. During this time the drifting sand is passing down the extractors and through the small pipes to the sand washer where it is cleaned and is again forced up the standpipe to the filter. This process is continuous.

About every ten days, according to the condition of the raw water, the filters have to be cleaned or back washed. The backwashing is done with filtered water from the wash water tank, which also gives the required head. The backwash water passes from a 36 in. main through the underdrain system and up through the gravel and filter bed, overflowing into the gutters where it is carried away through a 36-inch drain pipe to the lagoon. The valves during this operation are operated very slowly so that the gravel and sand bed are not disturbed. The dirty water from the sand washer is carried away in a small pipe connected to the waste pipe.

INSIDE VIEW OF FILTER UNIT BEFORE GRAVEL OR SAND HAVE BEEN PLACED IN POSITION.

Pumping Station—Boiler House

A reserve steam plant is installed, and in connection with it are four boilers for supplying steam to the turbo-generator set in the pumping station and also for the steam heating system.

The boiler house and pumping house are in one building but are separated by a brick division wall. The entire building is 142 ft. by 75 ft., the boiler house part being 75 ft. long by 40 ft. wide. The latter contains four 300 horse power, Scotch, marine type, dry back boilers built by the International Engineering Works, Amherst, N.S. They are each 11 ft. 8 ins. mean diameter, and contain 2,200 square feet of heating surface. Each boiler has two Morrison corrugated furnaces of 50 ins. inside diameter. To the rear end of each corrugated furnace are riveted three plain courses aggregating 7 ft., making a total length of furnace and flue of about 15 ft. In each course is placed a Galloway tube making six of these tubes to a boiler. These Galloway tubes are an interesting feature, tending as they do to improve materially the circulation. Each boiler has 142 tubes of 3½ inches diameter and spaced 4¾ inches between centres; also a manhole on the top of shell and one on the front head below the furnace. MacDonald shaking grates are fitted, and furnace doors are of balanced type.

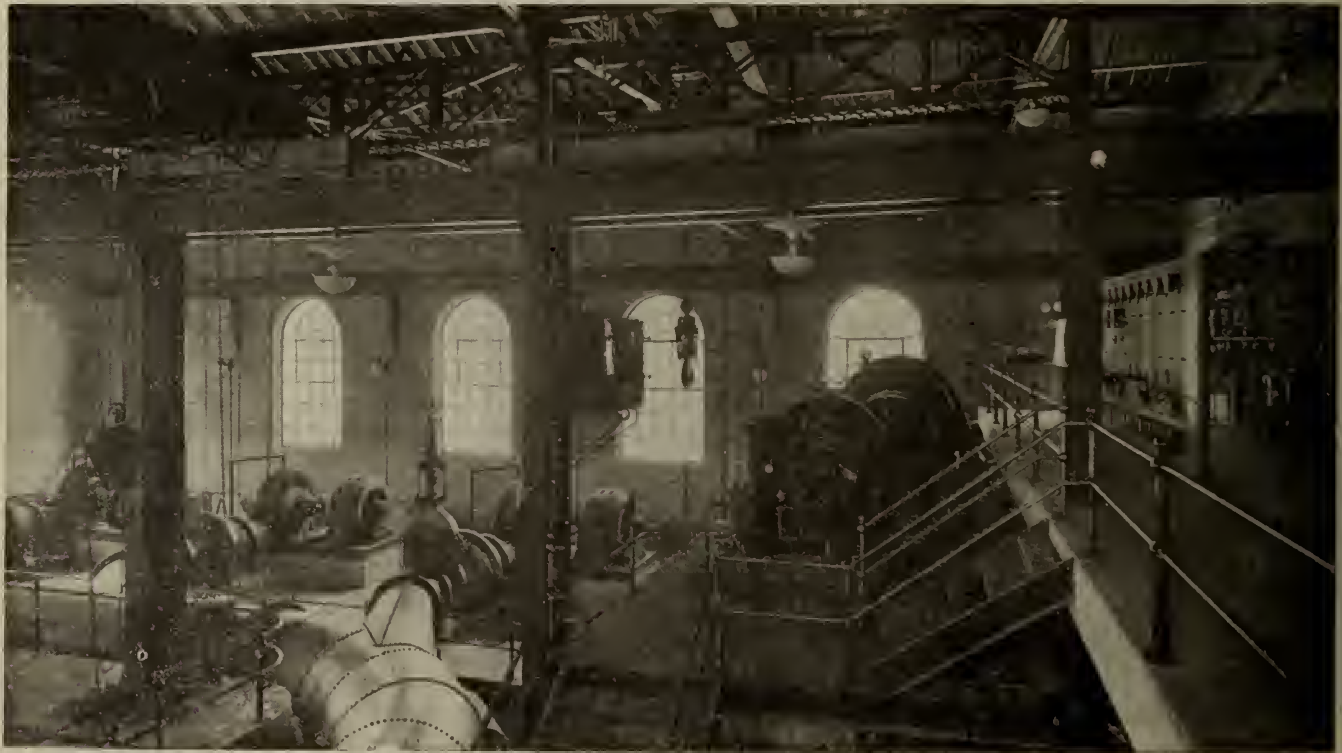
In the main flue leading to the chimney is located a balanced damper controlled by a Ford damper regulator. Each boiler is equipped with the following accessories:—One 8 in. main stop valve with by-pass; two ball and lever safety valves set for 150 lbs. working pressure; also two spring type safety valves; one 12 in. steam pressure gauge; two sets of large size water gauges; one feed check valve; one blow off valve and one blow off cock. In connection with the steam heating system there are two reducing valves, the final reduced pressure being two pounds. All the piping and fittings are extra heavy. The boilers, piping, valves, breeching, etc., will be covered with 85 per cent. magnesia, the latter being covered with 12 ozs. canvas, all supplied by the Philip Carey Co., Toronto. The breeching to smoke stack was built and installed by the International Engineering Works. A 12 in. steam header extends over all four boilers and is 50 feet long. The steam line from header to the pumping station is 6 ins. diameter.

The boiler feed pump was supplied by the Smart-Turner Co., Hamilton, Ont. It is a 10-6-12 ins., duplex, outside packed unit fitted with pot valves. There is also installed in the boiler house a 1000 horse power Cochrane feed water heater which takes the returns from the heating system, steam pumps and steam lines. A Bawden vacuum pump in connection with the heating system is also installed in the boiler house.

VIEW LOOKING ALONG FILTER GALLERY.

Pump House

The pumping station is 75 feet by 102 feet, and contains the three main



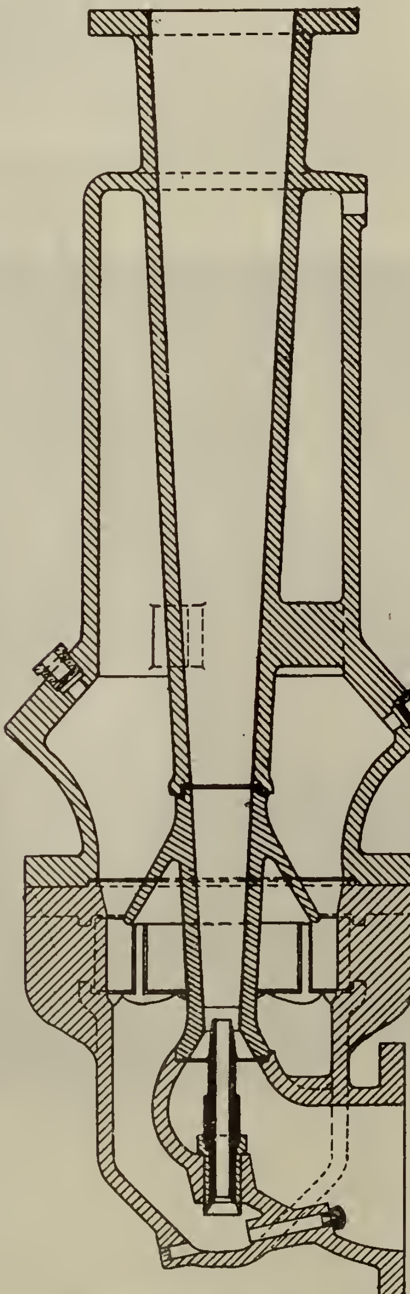
INTERIOR VIEW OF PUMPING STATION, SHOWING MAIN PUMPING UNITS, GENERATOR SET, AND SWITCHBOARD.

pumps, a steam turbo-generator set, switchboard, wash-water tank pumps, and pumps for hydraulic valve operating system. Ample space has been provided for installing equipment for other purposes in connection with water supply of the Island and City. The interior of the building is of buff brick with white glazed brick around the walls to a height of 4 ft. 6 ins. above floor line.

All the large pumps are situated along the South side of the building at a lower level than the main floor, while at the West end is a platform 5 ft. 6 ins. above the main floor, around the turbo-generator set. At the rear is the switchboard gallery, 3 ft. 6 ins. above the platform. The switchboard gallery is L shaped and contains at one end the main switchboard for the mechanical filter plant and a table from which hydraulic gate valves on the main pumps are operated. At the other end of the gallery is a venturi meter recorder for recording the flow in the 72 in., pipe and also a wash water tank level indicator. In the gallery, space has been allowed for additional switch boards, one for controlling the machinery for existing slow sand plant, and another also in connection with the old plant. These switchboards have not been installed at present but will be at a later date. Below the gallery are the transformers, wash water pumps, accumulator pumps, and drainage pumps. The pumping station has two bays, over each of which is a 12 ton Hepburn hand operated traveling crane. A covered passage connects the pumping station with the filter house. The 72 inch raw water main from pumps to the filters runs through this passage and has a 72 inch venturi meter in the line.

Filtration Pumps and Motors

Three 36 inch pumps are installed for pumping the raw water from the suction well to the filters, each pump having a capacity of 36 million gallons per 24 hours against a total head of 32 feet. They are of the De Laval type, direct connected by means of a flexible coupling to a Canadian Westinghouse 325 horse power, induction motor running at 360 r.p.m. The motors use hydro current of 2200 volts, 3 phase, 25 cycles. The pumps were supplied through and installed by the Turbine Equipment Co., Toronto. They are single stage, double suction centrifugal units with a guaranteed efficiency of not less than 77 per cent. The impellers are of bronze and renewable, the case and impeller rings being also of bronze. The hammered steel shaft is protected from the action of the water by bronze sleeves, and the pump casings are split on the horizontal centre line. Priming is secured by a 3 inch Penberthy ejector. Each pump is equipped with a check valve and gate valve on the discharge side. The 36 in. gate valves were supplied by Glenfield & Kennedy, Kilmarnock. Scotland, and are hydraulically operated from a control on the switchboard gallery. The discharge pipes from the pumps are connected to a main which increases in diameter from 36 in. to 72 in., the large end being connected to the main leading to the filter house.



DETAIL OF SAND WASHER.

Turbo-Generator Set

The pump motors are operated by hydro power, and during peak load, or in the event of the power failing, the steam turbo-generator set has been installed as a reserve. This unit is of the De Laval type and was supplied through and installed by the Turbine Equipment Co. The steam turbine is an 1800 horse power impulse type machine, having one velocity and twelve pressure stages. It is direct connected, through double helical reduction gears to a 1335 k.v.a. Lancashire dynamo of 2200 volts, 3 phase, 25 cycles, slow speed, revolving field type, with a d.c. exciter on the main shaft. The turbine operates at a speed of 3600 r.p.m., the generator at 500 r.p.m., the gear ratio being 7.2 to 1; the gear bearings are of the three pinion type. The initial steam pressure on the turbine throttle is 135 lbs. per sq. inch, and the exhaust is into a vacuum of 1½ ins. Hg. absolute. The guaranteed steam consumption is under 18 pounds per k.w.h. Under the turbine is installed a Wheeler low level type jet condenser with centrifugal condensing water and an entrainment centrifugal air pump. Both pumps are direct connected to a 45 horse power Lancashire a.c. motor.

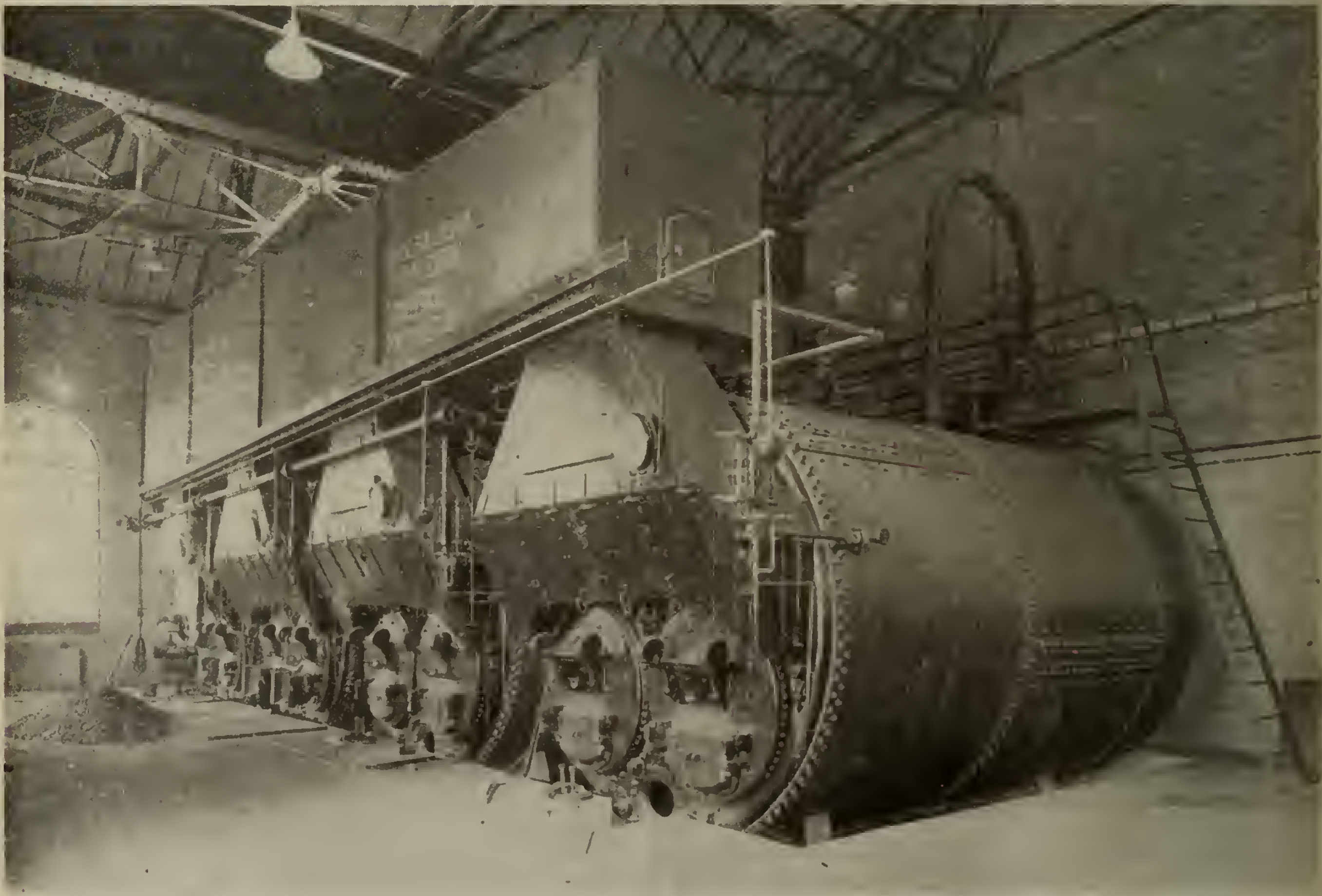
The turbine is fitted with a Jahns governor acting from a pilot valve that admits steam to a piston controlling the governor valve, the latter being a balanced double-seated unit. The steam admission is controlled by throttling. There is also an emergency governor consisting of a Schutte & Koerting trip and throttle valve which trips at about 10 per cent. above normal speed and stops the machine. The main steam pipe to the turbine is 6 ins. diameter and the exhaust to condenser, is 36 in. diameter. This unit is equipped with an oiling system. A rotary pump connected to the governor spindle pumps oil from a small collecting reservoir to an overhead Burt cooling tank. The oil returns through a filter under a pressure of 5 lbs. per sq. inch to the turbine and pinion bearings, and also to the manifold containing nine nozzles which supply oil to the gear and pinions. The oil is next carried by brass piping to a small reservoir, and after being strained is pumped back to the overhead tank. The turbine and pinion bearing are water cooled, and the gear and alternator bearings are of ring oiling type. A 6 in. Cochrane steam separator is installed in the line from boiler header to turbine, and is drained into a Squires trap.

Auxiliary Pumping Units

In the pumping station under the switchboard gallery are located various auxiliary pumping units, while there is also a De Laval booster pump situated near the main pumps. This booster pump has a capacity of two million Imperial gallons per 24 hours and is intended to be used when only a comparatively small volume of water is required for the filters or other purposes. It delivers into the raw water main and against the same head, viz. 32 feet, as the 36 in. pumps. It is also of the same general design as the large pumps and is direct connected to a 20 horse power Canadian Westinghouse alternating currents.

The equipment under the switchboard gallery consists of two wash-water pumping units, two hydraulic pumping units and two drainage pumps, the extra set in each case being a reserve unit. Each wash-water unit pumps water up to the wash-water tank for back washing the filters, and consists of a 5 in. De Laval contrifugal pump having a capacity of 350 Imperial gallons per minute against a head of 180 feet. It is direct connected to a 20 horse power Canadian Westinghouse, a.c. motor running at 1415 r.p.m. There are two of these units, each pump being equipped with a by-pass so that water can be obtained from various sources of supply.

The hydraulic pumps operate in connection with an accummulator and supply a pressure of 700 lbs. per square inch for operating the hydraulic gear on the various gate valves in the plant. These pumps are of Glenfield & Kennedy, vertical triplex type, driven through worm gearing by a Lancashire motor, each of the latter being a 7½ horse power, 550 volts, 3 phase, 25 cycle machine, automatically controlled by Cutler-Hammer switches and relays. The drainage well or sump is located under the switchboard gallery. The bottom of the well is the lowest point in the plant and so collects the drainage from any part. The well is 9 ft. diameter and 15 ft. deep, and is cared for by two vertical De Laval 6 in. centrifugal single stage pumps. Each pump has a capacity of 700 Imperial gallons per minute against a total head of 20 feet, and is direct connected to a 7 horse power Canadian Westinghouse vertical a.c. motor. The motors are automatically controlled by Cutler-Hammer self starters.

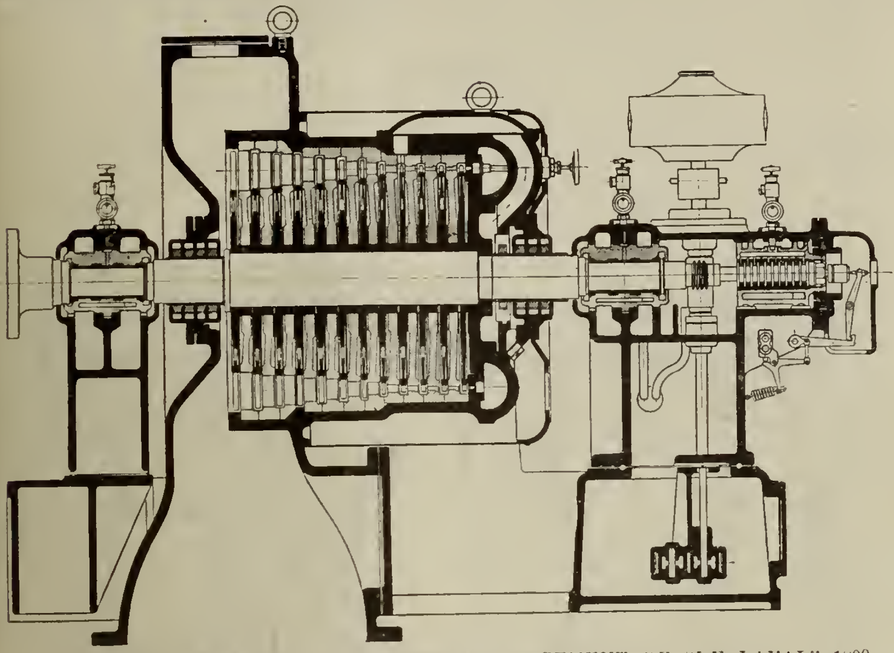


BOILER ROOM SHOWING BATTERY OF FOUR MARINE TYPE, TWO-FURNACE DRY BACK BOILERS.

Switchboard and Transformers

The main switchboard was supplied and installed by the Canadian Westinghouse Co. It is made of blue Vermont marble, of standard construction, and has 15 panels. It is 25 ft. 4 ins. long, and 7 ft. 6 ins. high. The first panel belongs to the exciter; the second controls the turbo-generator; the third is for the incoming line from the Hydro system, while the fourth, fifth and sixth panels control the three 325 horse power main pump motors. The seventh panel is connected to the three 50 k.w. transformers, the range being 2200—550 volts for the small motors. The eighth panel controls the two 25 k.w. lighting transformers, 2200—220—110 volts; the ninth controls the 20 h.p. booster pump motor; the tenth, the 45 h.p. condenser pump motor, and the eleventh, the two 7½ h.p. sump pump motors both fed from the one switch and controlled by the Cutler-Hammer auto starters. The two 20 h.p. wash-water pump motors are controlled from panels twelve and thirteen, while the fourteenth panel controls the two 7½ h.p. motors with one Cutler-Hammer auto starter and double throw knife switch for operating the hydraulic pumps. The last panel is blank being reserved for future equipment.

At the left hand side of the switchboard is a swinging bracket with a volt meter, 150 scale for the d.c. exciter, a volt meter with a 3000 volt scale for the a.c. generator and a syncroscope. On the incoming line panel there is a graphic recording wattmeter and an intergrating meter on the generator panel. On the generator panel there are also two ammeters, a.c. and d.c.; a frequency meter and an indicating wattmeter. On the incoming line panel there is an ammeter and a power factor meter. On each panel there are the usual operating handles for the oil switches and a pair of relays, the general layout being arranged to use hydro current or the power generated at the plant. On the wall behind the switchboard are mounted the remote controlled oil switches, also the starting and running buses on the 2200 and 550 volt motors. The transformers are of Canadian Westinghouse make, and consist of three 50 k.w. units transforming the line current at 2200 volts down to 550 volts for the small motors, and two 25 k.w. transformers for the lighting system which is 3 wire, 220-110 volts. All motor connections are made in lead-covered triple conductor cable.

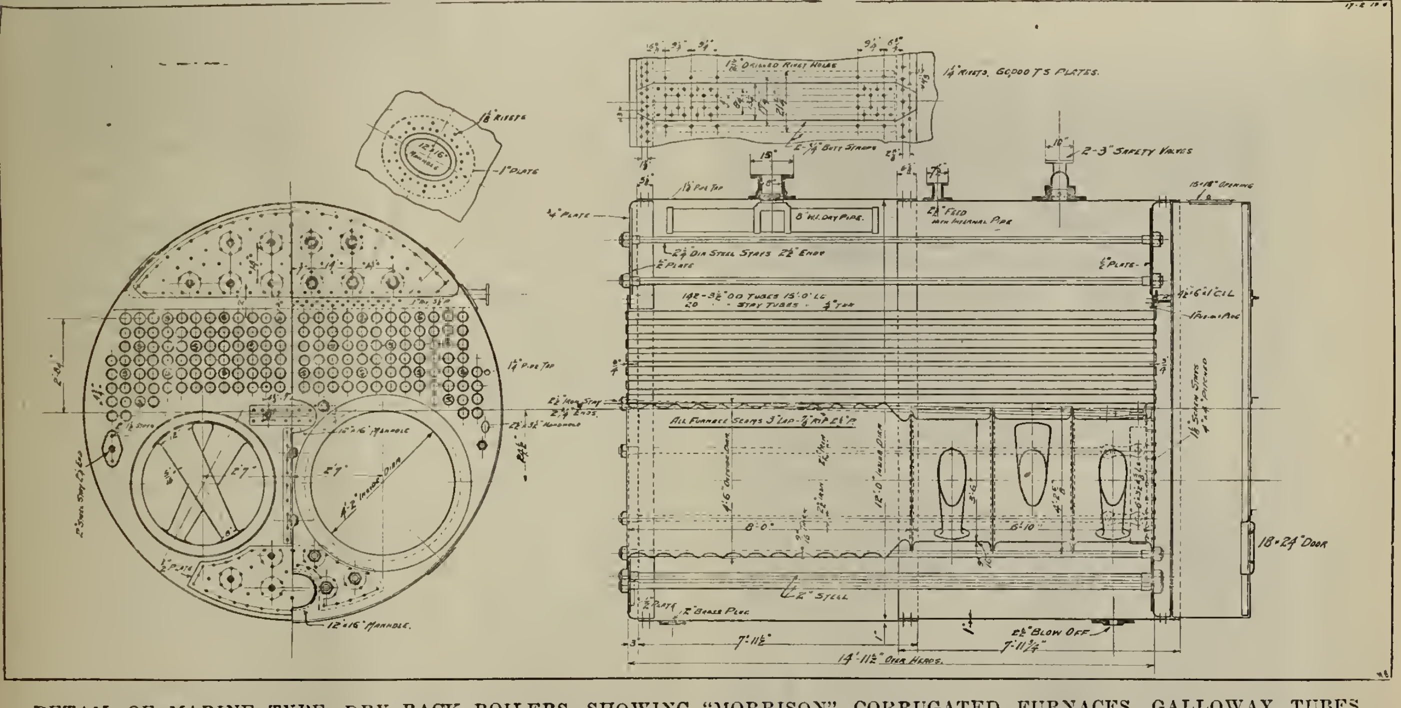


AXIAL SECTION, SHOWING GENERAL ARRANGEMENT OF "DE LAVAL" 1800 HORSEPOWER, IMPULSE TYPE, MULTI-STAGE STEAM TURBINES.

Steam Heating System

The steam heating system was designed and installed by Bennett & Wright, Toronto. It is of the low pressure vacuum type, steam being obtained from a valve on the boiler header and passed through two extra heavy Kiely & Mueller reducing valves. The first valve reduces the pressure to 80 lbs. and the second to 10 lbs. There is a connection between these two valves to the heating system in the wash water tank. The layout of the system generally does not present any unusual features except in the filter house where the steel tanks and large surface area of contained water had to be taken into consideration. Attention had however to be given to the matter of the wind pressure on the filter house tending to drive the heat to the opposite side of the building causing inequality of temperature. The total amount of radiation is 17,940 sq. ft. made up principally as follows. Filter house 15,144 sq. ft.; pumping station 1764 sq. ft.; suction well building 612 sq. ft.; chemical house 324 sq. ft.

In the filter house the temperature has to be maintained at 50 degrees Fahr. At the ground floor level, radiators are suspended under the windows on the walls by special steel hangers. The radiators are arranged in two 12 ft. sections one above the other. Radiators are also suspended on the operating gallery and on the skylight. The heating of the entire building can be controlled from a point midway on the operating gallery. At this point is a header with eight connections to various sections of the building, each connection being controlled at the header. The main steam line to header and the header itself are both 9 ins. in diameter. The header controls are as follows:—One for the window low level radiators West side; one for those on the East side; one for the gallery radiators South section; one for the North; two for the coils on the West



DETAIL OF MARINE TYPE, DRY BACK BOILERS, SHOWING "MORRISON" CORRUGATED FURNACES, GALLOWAY TUBES, ETC. MEAN DIAM. OF BOILER SHELLS, 11 FT. 8 INS.; LENGTH OVER HEADS, 14 FT. 11¼ INS.; FURNACES 50 INS. IN DIAMETER INSIDE CORRUGATIONS; 142 SMOKE TUBES 3½ INS. IN DIAM.; WORKING PRESSURE 150 LBS. PER SQ. INCH.

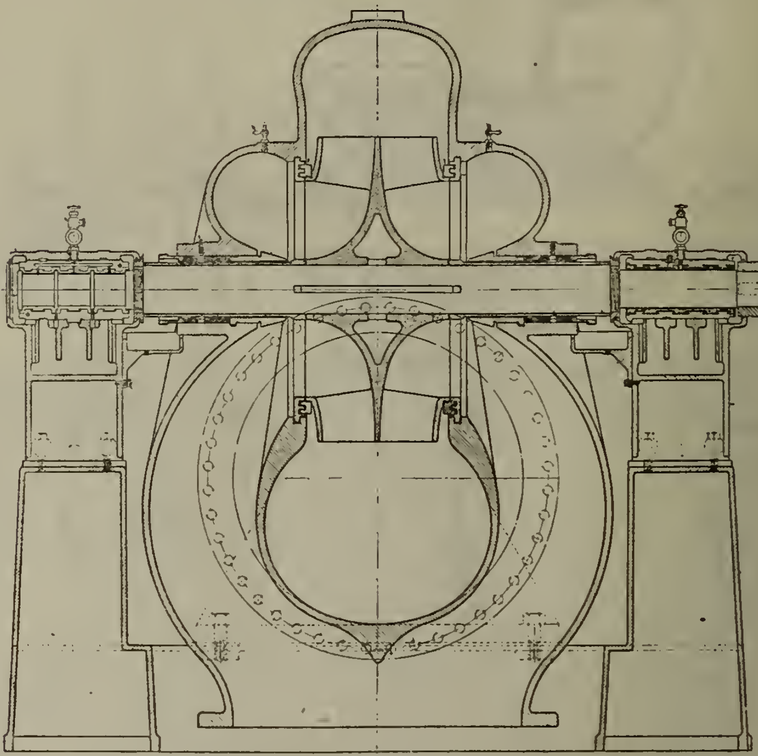
and East sides respectively; two for the skylight or monitor radiators East and West; the centre connection being the steam supply. The control system was adopted in order to equalize the temperature when the wind pressure, already referred to, drives the heat from one side of the building, making the other side too warm, in which case radiators on the warm side would be cut off. The filter house has 15,144 sq. ft. of radiation.

The pumping station has 1764 sq. ft. of radiation and all the radiators in the building have hand valves, and also a "vento" vacuum trap on the return line. These traps allow air and water to pass through but hold steam in the radiator. The chemical house has 324 sq. ft. of radiation and the suction well building 612 sq. ft. The installation in these two buildings is precisely the same as in the pumping station. These three buildings have to be maintained at 70 degrees F. in zero weather.

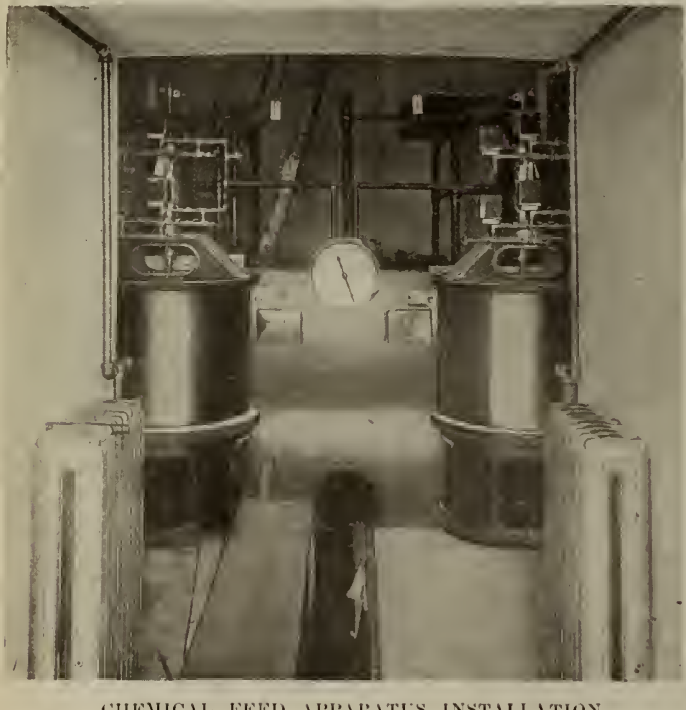
The wash water tank is heated by steam at 80 lbs. pressure taken from a point between the reducing valves on the boiler. This line is connected to a 2 in. pipe around the tank inside, the steam mixing wth the water. A Bawden 40,000 sq. ft. 8-10-10 ins. vacuum pump is installed in the boiler house for drawing the returns from the system under from 10 ins. to 15 ins. of vacuum to the "Cochrane" heater also in the boiler house. The pump is controlled by a Foster vacuum govenor. All main steam lines are covered with air cell covering and the radiators are painted with two coats of old bronze. The radiators were supplied by the Dominion Radiator Co.

Lighting System

The lighting is on the 3 wire, 110-220 volts, single phase, distribution system and was installed by E. F. W. Salisbury Ltd., Toronto. The distributing mains are run underground from the switchboard to the various buildings, the circuits being run to Crouse-Hinds panel boards enclosed in steel cabinets. The wires are carried in galvanized conduits supplied by Conduits, Ltd., Toronto. The lighting in the chemical house consists of two 40-watt lamps on each landing, also four 100 and one 25 watt lamps with reflectors in the chemical storage. In the coal storage are ten 60-watt lamps. In the suction well building is a cluster light containing five 100-watt lamps. In the pumping station there are ten wall brackets, each with a 200-watt nitrogen filled lamp and angle reflector. There are also six suspended semi-indirect lights, each having a nitrogen filled lamp, and sixteen 60 watt lamps in various parts of the building. In the boiler room there are twelve 60 watt lamps and one 100 watt lamp with reflector. There are six 60-watt lamps installed in front of the boilers, near the water gauges. In the filter house there is one cluster light containing five 100 watt lamps over the centre of each tank, equipped with special reflectors. There is also a lamp at each operating table, making a total of 15 lights, ten of 500 watt capacity and five of 300 watt capacity. There are also a number of lights around the bottom of the tanks and on the stairways. The wharf is illuminated by means of nine 300 watt lamps mounted on brackets.



SECTION THROUGH "DE LAVAL" 36 INS. CENTRIFUGAL PUMP.



CHEMICAL FEED APPARATUS INSTALLATION.

Efficiency of Plant

In conclusion it should be mentioned that both buildings and equipment represent workmanship of high order. The plant is unusually interesting from an engineering standpoint as it is the first one of its kind to be installed in this country. The contract requires that the filtration plant shall remove 98 per cent. of the B. coli as determined by the standard methods of the American Public Health Association. All turbidity must be removed leaving a bright colorless water free from taste. Such results must be obtained by the use of not more than one grain of alum per gallon of water under average conditions. Among the sub-contractors not already mentioned are included the following:— Cast iron pipe was supplied by the Canada Iron Corporation and the Standard Foundry; all venturi water meters by the Builders' Iron Foundry, Providence, R.I.; filter tanks and steel pipe were made by the Thor Iron Works, Toronto; handrailing, steel stairway and window sash by the A. B. Ormsby Co., Toronto; bricks came from the Don Valley Brick Works, Toronto, and the structural steel was supplied and erected by the Dominion Bridge Co., Montreal and Toronto.

CANADIAN PEAT RESOURCES

ATTENTION is being drawn to the possibility of expansion of Canadian commerce and industry as a result of the war. This may take the form of domestic production of articles for a supply of which Canada has been dependent upon foreign sources, or of increased exports to other countries of products hitherto supplied by Germany and Austria. Among other things, this emphasizes the importance which development of the latest resources of Canadian peat bogs might readily assume if full advantage of the new conditions arising from the war were taken. Sulphate of ammonia, the chief by-product of European peat plants, is a valuable fertilizer worth about $60 per ton. The world's production last year is estimated at 1,365,000 tons, worth about $80,000,000, says the Journal of the Canadian Peat Society.

Many Canadian peat bogs are rich in nitrogen, and, therefore, suitable for this industry, and inquiries have already been made by British capitalists with a view to establishing chemical works in Canada, provided that a sufficient supply of peat can be guaranteed. Apart from the potential value of our peat bogs as a subsidiary source of fuel supply and for production of sulphate of ammonia, there are numerous other products, such as moss litter, peat dust, alcohol, acetic acid, acetone, tar, tar oils, creosote, etc., which might form the basis of paying industries, giving employment to many people, where now we have only waste lands.

Provincial Locations

Systematic investigation of the peat bogs of Canada with a view to ascertaining their location, extent, depth, character and suitability for production of fuel and litter has been carried on since 1908. During the period from 1908 to the close of the season of 1914 there have been located, delimited, mapped and investigated as to depth, character and quantity of peat available for commercial exploitation as fuel or litter. twenty-five bogs in Ontario, twelve in Quebec, eight in Nova Scotia, six in Prince Edward Island, and seven in Manitoba, fifty in all, covering about 140,000 acres altogether and estimated to be capable of yielding about 115,000,000 tons of fuel. Twelve bogs were found to be in part or as a whole adaptable for production of peat litter, having an estimated capacity of production of about 10,500,000 tons. Seven Ontario bogs investigated within convenient shipping distance of Toronto are estimated to be capable of producing approximately 26,500,000 tons of fuel.

Seven bogs in the Montreal district could furnish that city with 23,500,000 tons of fuel. Five bogs along the Lower St. Lawrence in Kamouraska and Temiscouta Counties, convenient to the City of Quebec by water, are estimated to be capable of supplying 16,250,000 tons of fuel and 5,750,000 tons of peat litter. Nova Scotia bogs investigated in Yarmouth, Shelburne and Lunenburg Counties will produce 6,250,000 tons of fuel and 500,000 tons of peat litter. Six bogs investigated in Prince Edward Island can furnish 1,250,000 tons of fuel and over 1,000,000 tons of litter. In 1913 Canada imported artificial fertilizers to the value of $737,656, showing that there is quite a market in this country for peat by-products.

STEEL CHIMNEYS

STEEL smoke stacks are specially suitable for use on soil which could not easily be made to bear the weight of a brick stack, in cases where speedy erection is an important consideration, and in temporary boiler installations, or where alterations or extensions are likely soon to be required. Steel chimneys do, however, find extensive application in more ordinary and permanent installations, and they have recently been used to discharge waste gases other than boiler flue gases into the atmosphere.

Chimneys of this type are cheap and can be bought ready-made, or even built by the works requiring the new stack. On the other hand, an unlined steel chimney loses much draught by heat conduction through, and radiation from, its plates, particularly in cold weather and high winds. To prevent rapid deterioration by external rusting the chimney must be painted at least once in two years with tar or some other weather-proof material. Internal rusting occurs near the top of the stack, due to rain. which drives into the chimney; lower down the "sweating" of the plates (condensation of the moisture and vapors in the flue gases) leads to further rusting and to a considerable amount of electrolytic and direct chemical attack, since the condensates from the gases are strongly acidic.

In order to minimize internal corrosion, steel chimneys are almost invariably lined with refractory bricks, specially formed hollow bricks being often used for the sake of lightness. The provision of such a lining reduces materially the loss of heat from the chimney, increases the stability of the latter, and, in fact, yields a construction which combines the merits while eliminating the demerits of brick and unlined steel stacks.

DEVELOPED WATER POWERS IN BRITISH COLUMBIA

THE accompanying detail statement shows at a glance the developed water powers of the Province of British Columbia, and indicates at same time those owned and operated by public utility corporations, as well as those privately owned. The horse-power developed is given in each case:—

Owners and Location.	Horse-power.
Public Utilities	
Vancouver Power Co. (B.C.E.R. Co.). Lake Coquitlam and Lake Buntzen	84,500
Western Canada Power Co., Stave Falls	26,000
Vancouver Island Power Co. (B.C.E.R. Co.), Jordan River	25,000
Goldstream	3,000
Nanaimo Electric Light, Power & Heating Co.	870
Duncan, Vancouver Island	160
City of Prince Rupert, Woodworth Lake	1,650
Ashcroft	100
Kamloops City, Barriere River	2,800
Revelstoke City, Illecillewaet River	600
Golden, city	1,200
Armstrong (Okanagan)	335
Enderby (Okanagan)	100
Peachland, Trepannier Creek	70
Summerland, Trepannier Creek	40
Naramata, Trepannier Creek	40
Penticton, Trepannier Creek	135
City of Nelson, Kootenay River	4,000
West Kootenay Power & Light Co. (Bonnington Falls, Kootenay River, Kettle River, Cascade, near Grand Forks)	23,000
City of Greenwood Waterworks Co.	170
Kaslo	160
Sandon	100
Denver Power & Light Co., New Denver	100
Cranbrook	440
Fernie	400
Coal Creek	630
Michel	670
Athalmer	30
Privately Owned	
Canadian Collieries (Nanaimo), Puntledge River	9,400
Britannia Mining & Smelting Co.	2,735
Power River Co., Powell River	24,000
Ocean Falls Co., Link River, Ocean Falls	11,200
Swanson Bay Forests Wood, Pulp & Lumber Mills, Ltd.	1,250
Granby Consolidated Mining & Smelting Co.	7,325
Hedley Gold Mining Co., Similkameen River, near Hedley	2,650

Power Transmission Section

FRICTION CLUTCHES—I.*

By W. G. Gass.

IT is a little difficult to know where to commence the treatment of a subject like a friction clutch, which is not a machine in itself but only a part of machinery, and of which there is so great a variety, so many makers, and such extended use. It is not therefore proposed to deal with any one type, but to review the general types into which they may be classified, to refer to their common points and detail, and as far as possible their weaknesses and faults; not with the idea of extolling one type against another, but by bringing their faults to view to help towards their removal, for it is only by consideration of weak points that we can strengthen them. It may be taken as an axiom, that though one type of clutch may have advantages over another, there is not any perfect clutch, some types answering better than others for different classes of work; this is a great point to bear in mind when arranging clutch drives.

Clutch Types

We may commence by defining a clutch as a mechanical device by which rotary motion is transmitted from a first motion shaft to another or second motion shaft, which may be either in the same straight line or parallel with it. Clutches are divided into a number of distinct types:—Claw couplings, friction cones, internal segment and band clutches, external segment and band clutches, plate clutches, brush clutches, magnetic clutches, automatic clutches.

Claw couplings cannot be generally classified as friction clutches, but they can be and are combined with a friction slipping device by which some of the shock is absorbed when thrown into gear with the prime mover when rotating. Without any friction they are very useful on machines where the load is not very great, as they have all the advantages of giving a drive with no chance of slip. Where used for transmitting heavy loads, or at high speeds, they should only be put in gear when the machine or shafting is stopped. They are also very difficult to release when transmitting heavy loads.

Friction Cones.—These are the simplest form of friction clutch, and for some purposes the best, because simple in construction; if properly made they drive very well. They have the serious defect for general use of requiring to be held up with a constant pressure, which absorbs power and causes wear on the setting-up gear, with the bearings taking the thrust of the setting-up gear. A portion of the constant thrust can be eliminated by making the angle of the internal portion sufficiently small, but this makes the cones liable to stick, and it is not infrequent, when large cones are so made, to have to hammer the outside of the cone to make the two portions come apart. If, on the other hand, the cone angle is too large, the pressure required to keep the two parts in gear is so great that it is very difficult to transmit the power. Generally these large cones are used for driving machinery in bleach-works and similar places, and are useful where there is a good deal of wet about. They are usually made of cast iron, the inner part sliding on the shaft on float keys, the outer part running loose on the shaft. They have been tried as double cones with internal and external bearing surfaces, but there is nothing to justify such an arrangement. If covered with some frictional substance such as leather, or any of the numerous frictional materials made for the purpose, the driving power is increased.

In motor cars the cone has proved a most valuable type, as the usual conditions are reversed, and it is as a constant driver that its value comes in. The arrangement in motor cars is such that there is no end thrust except when it is not transmitting power, and is, therefore, working under the best conditions.

Internal Segment or Band Clutches.—These are divided into two distinct types, those in which the internal segment is in two or more sections, which are forced apart— by means of screws usually, and those in which the internal segment is cast all in one piece, so arranged, that the driving portion is expanded against the spring of the metal. This type is made in two forms; in one case the segment is sprung apart in two points, and the other in one place only. Similar forms are made with hinged portions. In the loose segment type, the segments are carried on the arms of a turned internal piece, usually keyed on to the shaft as driver, but in other cases sliding in grooves made to receive them in the driven portion.

The External Segment or Band Clutch, is made in quite as many forms as the internal band type, but is more generally used for the smaller powers. The segments are in two, three or four pieces forced on to a central drum and carried in much the same way as the previous type. A single band similar to brake drum strap gripping on a central drum and set up by a wedge is one form; another has two bands and is set from opposite sides. Another takes the form of a spring coil which tightens up by tension and friction, and is, in fact, an external cone clutch with a flexible rim. It is not usual to consider a fast and loose pulley drive as a clutch, but it comes under this head, the belt being the external friction band.

A Plate Clutch is distinct from any of the other forms, as the gripping surface is between two or more flat plates pressed together, one plate being attached to the driver and the other to the driven alternately. These are forced together by levers through a toggle joint. Another form of this type has the plates of stamped steel formed into a kind of double cone, which is supposed to give it extra gripping powers.

Brush Clutches.—These utilise the resistance of a great number of projecting wires, which when the two portions are pushed together, interlock and give the necessary power of driving.

Magnetic Clutches have generally two flat faces, though conical surfaces have been used, which are pulled together by the power developed in an electro magnet formed in one half the clutch.

Automatic Clutches depend on centrifugal action to keep the surface in contact, and are used in connection with electric motors, being designed usually to come into operation at certain desired speeds. The foregoing brief summary of the different types make it evident that their number is very great, and that it would take more than the space available to describe them in anything approaching detail. They, however, all possess good points and faults in common, and it is these which it is proposed to consider as well as their other features in what follows:—

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*Read before the Manchester Association of Engineers.

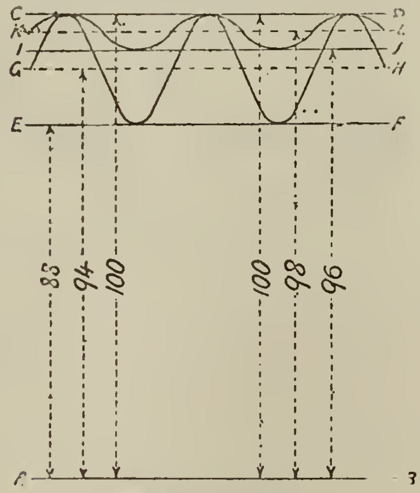
Driving Surfaces

These are for the most part metal on metal, usually cast iron on cast iron. In cones, and in internal segment clutches, in the old days they used to be covered with copper plates riveted on by copper rivets. Many of the oldtime millwrights, particularly in bleach and similar works, would not have anything else, but there are not many made so at the present time. Copper covering did not materially increase the driving power, but it was generally believed to do so. If the clutch were heavily loaded there was a tendency for the copper to creep and shear the rivets. Examination of the surface of the copper after long work showed the surface to be embedded with fine particles of iron from the outer part of the cone or clutch, and it became hard and glazed, the pieces of embedded iron being hard and exceedingly sharp.

There are several kinds of friction material now made which are recommended for clutches. These, no doubt are of advantage for brakes, but there are difficulties in the way of using them for clutches. In most cases rivets have to be depended on, and these are apt to give way. The material is liable to glaze, particularly where the clutch goes in and out many times. Wooden blocks as driving surfaces act very well if the load is not excessive, but if overtaxed they char on the surface and give way. Where steel is used it should not rub on cast iron unless its surface is chilled very hard, or, if on steel, on a casehardened surface. Some of the smaller kinds of clutches use two hardened surfaces, but this must reduce the driving power.

In plate clutches, cast iron on cast iron is, in the Authors opinion, best, mild steel on cast iron being a failure. One clutch uses a double cone arrangement in which the pressure is on the inside and the outside, and steel plates are used throughout. A great deal is claimed for this, and it is satisfactory as long as it is attended to and not overloaded. In motor cars, leather faced cone clutches are in the majority, and the results justify their popularity; they have to work so much as a slipping clutch that metal to metal surfaces have not proved satisfactory unless lubricated. In these, the co-efficient of friction is of course higher than metal to metal. In magnetic clutches, fibre on iron is usual, and they are said to give good results.

The trouble of driving surfaces is that they wear away, and this wearing is greater or less as the clutch slips or not. It is obvious that faces of metal cannot slip on one another under pressure without wearing away, and the examination of surfaces which have been in use shows the way in which the loss occurs. The surfaces generally being dry, a small portion of metal gets embedded into whichever of the surfaces is the softer, and acts as a kind of plough into the other. It is not necessarily the softer of the two which gives way, but often the harder. This does not sound quite reasonable but it is a fact. If you take a lead plate and cover it with particles of emery it will cut away the hardest steel. It is not, of course, the lead plate that cuts but the emery. The same thing occurs with the clutch; particles of hard material get embedded in the softer and act as the cutting material, but only when the clutch is slipping, so that the wear may be slow or fast depending on whether the driving faces slip much on each other. This explains why clutches put in as slipping clutches are not often very successful.



SPEEDS DIAGRAM.

* * *

IMPORTANCE OF UNIFORM DRIVING IN TEXTILE MILLS*

By Prof. G. F. Charnock.

THE money value of uniform turning and of close speed regulation in the driving of textile machinery is not appreciated as it ought to be. Steadiness and regularity of driving is an important factor in determining the maximum speed at which machinery may be run with the highest degree of efficiency. Uniform turning of the spindle is essential to the production of an even and level yarn, whilst in weaving, steady turning of the loom is of great importance in reducing the risk of broken threads. It will be recognized that for spinning and weaving machinery there is a maximum speed which the material will stand, and which must not be exceeded. To ensure the maximum output it is, however, desirable to approach this critical speed as closely as possible during the whole time the machinery is at work. The amount of yarn or of fabric produced depends upon the average speed, and the maximum possible efficiency as regards output would be reached when the average and maximum speeds coincide. The adjoining figure illustrates this point.

Taking a base line AB, a line CD is drawn to represent the maximum speed which must not be exceeded. Suppose the variation in speed occurring during the running of certain machinery amounts to 12 per cent., a figure which is frequently reached in the case of looms. At certain periods, the speed then falls to a minimum represented by the line EF, the fluctuation being shown by the wavy line of the diagram. The average speed, indicated by the line GH, will be

$$\frac{100 + (100 - 12)}{2} = 94 \text{ per cent.}$$

of the maximum, and so far as output is concerned, the efficiency might be stated at 94 per cent. Suppose now that it is found possible to reduce the speed variation from 12 per cent. to 4 per cent., the minimum speed is then given by the line IJ, and the curve between CD and IJ shows the fluctuation in speed between the extreme limits. The average speed is, therefore KL, or

$$\frac{100 + (100 - 4)}{2} = 98 \text{ per cent.}$$

of the maximum, and the output has been increased from 94 per cent. to 98 per cent., or

$$\frac{98 - 94}{94} \times 100 = 4.2 \text{ per cent.}$$

If the speed variation could be reduced to 2 per cent.—an extremely doubtful contingency — the average would be 99 per cent. of the maximum speed and the increase in output as compared with the first case would be

$$\frac{99 - 99}{94} \times 100 = 5.3 \text{ per cent.}$$

If it were possible to do away with speed variation altogether, the average speed would be 100 per cent. of the maximum, and the increase in output, as compared with a 12 per cent. variation, would be

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*From Journal of Department of Textile Industries in City of Bradford Technical College.

$$\frac{100 - 94}{94} \times 100 = 6.3 \text{ per cent.}$$

This is, of course, a saving which is quite impossible of achievement in practice. Nevertheless, claims to effect an increase in output due to the cause named, and of much greater amount, in some cases as much as 30 per cent., have frequently been put forward. It is evident that such a result cannot be obtained, even in the case of a notoriously bad drive, by reduction of speed variation alone. Where any such saving has been effected, it is much more likely to be due to a general speeding up of machinery which had previously been allowed to run at a speed much below the maximum permissible. Many such cases exist, and the ease with which a considerable improvement in output may be obtained in this manner is worthy of the attention of every millowner. The gain due to a reduction in speed variation of, say, 3 per cent., does not in itself appear to be a very striking matter, but if the mean speed can be increased 3 per cent. without increasing the maximum speed, this is equivalent per week of 55 hours to a gain of 1 hour and 39 minutes in actual time. Viewed in this light, the problem of close speed regulation is one which no power user can afford to neglect.

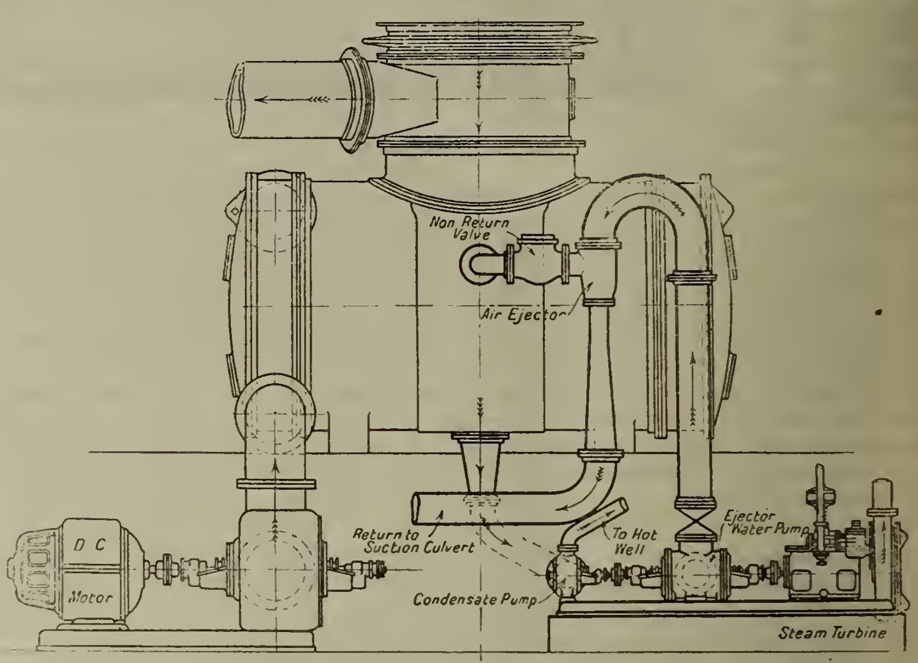
* * *

TEST OF A LARGS SURFACE CONDENSER

SOME test results obtained on one of five surface condensing plants, embodying a rotary air pump system, designed by Willans & Robinson, Rugby, England, and recently installed at the London & South Western Railway Co.'s Durnsford road power station, have now been made available. The station contains five identical plants, all of the same capacity, in addition to two small similar plants; all of them operate on the same principle.

The main feature of the system is that the circulating water is passed through an ejector, shown in the accompanying cut, which takes the place of the ordinary air pump. A separate condensate pump is provided to withdraw the condensed steam from the surface condenser, and to return it to the hot well. An automatic non-return valve is placed between the air ejector and the main condenser body so as to prevent water being drawn into the condenser in case of failure of the ejector. There are three common forms of application of the system, known as the "series," the "shunt," and the "separate pump" types respectively.

In the case of the "series" type of plant, the whole body of the circulating water is passed through the air ejector before it enters the condenser—that is to say, the circulating pump is designed for the normal quantity of water required by the condenser, but allowance is made in calculating the head for the necessary drop across the air ejector. In the case of the second or "shunt" system, the cooling water for the condenser and the ejector water are delivered in parallel and the ejector water is returned to source of supply or to circulating water suction. In other words, the circulating pump is designed for the normal head required by the lay-out of the plant, with allowance for condenser friction, and the quantity delivered is that needed for the condenser itself, plus the necessary water for the air ejector. The third, or "separate pump" type, of which the London & South-Western installation is an example, differs from the "shunt" system only in that a separate pump is provided for delivering the air ejector water, as apart from the main circulating water pump, which supplies the condenser in the ordinary way.



ARRANGEMENT OF CONDENSING PLANT AS TESTED.

In the present installation, both the main circulating pump and the ejector pump draw their water by means of a common suction pipe from the main suction culvert, which runs the full length of the engine-room. The water coming from the condenser itself is, of course, heated and passed to the delivery culvert, but the air ejector water is returned to the suction or inlet culvert. It will be noted that in this instance the circulating pump is driven by means of a continuous-current motor, whereas the ejector pump and condensate extraction pump drive is by small steam turbine.

The tests were carried out in the presence of the representatives of the consulting engineers, Messrs. Kennedy and Donkin, and of Herbert Jones, chief electrical engineer to the London & South-Western Railway Company. It will be noted that the vacuum attained is substantially above that guaranteed, and the makers draw particular attention to the low difference between the circulating water outlet and vacuum temperatures.

Trial number	I.	II.	Guarantees
Duration of test	60 min.	60 min.	
Load, pounds of steam per hour	68,176	68,389	68,000
Vacuum at steam inlet to condenser, corrected to 30 in. barometer	28.73in.	28.76in.	28.5in.
Corresponding steam temperature	86 6° F.	86° F.	92° F.
Condensate temperature	82° F.	82.5° F.	87° F.
Difference between condensate and vacuum temperatures	4.6° F.	3.5° F.	5° F.
Circulating water inlet temperature	58.5° F.	58.5° F.	65° F.
Circulating water outlet temperature	80.8° F.	81.1° F.	83° F.
Difference between circulating water outlet and vacuum temperatures	5.8° F.	4.9° F.	9° F.
Cooling water, gallons per hour	318,000	317,600	396,600

Note.—The test was carried out after the plant had been in service for a considerable period.

Electricity and Hydraulics

BEARINGS FOR ELECTRICAL MACHINERY—II.*

By Andrew Gibson.

BEARINGS are seldom made of solid white metal except in the case of small die-cast bearings. As a rule white metal is used only as a lining in bearing shells of cast iron, malleable cast iron, or bronze. Cast iron is the most commonly used material for bearing shells of all types of stationary machines, on account of its strength, good working qualities and low cost.

All shells should be properly tinned with good solder before lining; cast-iron and malleable cast iron bearing shells are sometimes provided with anchor holes to hold the lining in place. Bronze shells, properly tinned, require, as a general rule, no other provision for holding the metal in place. In order to clean the surface and to have a lining of uniform thickness, all bearing shells should be bored before lining.

The correct temperature at which to pour is about 575° Fah., but in the absence of a thermometer, a rough test for judging the correct heat is to dip a piece of dry, ordinary white writing paper into the metal. If the paper enters freely and merely turns light brown it is quite hot enough; if it burns it is too hot. A slow fire should be used when melting the metal in order that the metal at the bottom of the pot shall not be overheated while the rest is still unmelted. When the metal has melted care should be taken to prevent it being overheated; this very easily happens, as it requires much less heat to keep the metal molten than to melt it.

Overheated Metal.

If the metal has been overheated accidentally, it should be cooled down at once before it is poured into the bearing. A metal which has been overheated and cooled down is not so good as one which has never been overheated. A black ash forming on the surface indicates that the metal is being burnt; when the metal is at a right heat it should show clean and bright when skimmed. It is important to pour bearing metal at the correct temperature, as otherwise its structure and strength will be affected. It will be found much safer to have a fair quantity of metal in the pot, as with a large body of metal sudden rises and falls of temperature are less likely to take place within the pot. When the metal is to be kept hot for some time, it should be covered with a thin layer of vegetable charcoal. Turnings and scrapings should not be melted alone but be stirred into a pot of molten metal, using three parts of new metal to one of turnings. The same remark applies to old metal. Also, metal which has been melted and remelted four or five times should be treated as old metal.

Preparing For Pouring

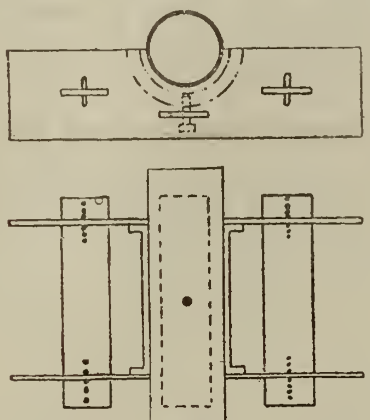


FIG. 4.

Having melted the metal, the next operation is pouring it into the shell, but before this is done all shells and mandrils should be heated until the tinned surface on the shell begins to run, a test being made from time to time with a strip of solder. Heating should be done in an oven, but may be done over a gas or coke fire, or with a gas blow pipe or spirit lamp. Paraffin should not be used in the blow-lamp nor should an ordinary gas jet be used, as neither gives a clean flame. The flame should not be allowed to play on the tinned surface or a film will be formed which will prevent the metal adhering. If the metal does not stick to a shell which has been properly tinned, it may be because the flame has reached the tinned surface and oxidized it, or the shell has been made too hot, oxidizing the surface, or because the shell has been lined very thickly or filled solid, in which case the non-sticking may be due to the metal having shrunk away from the shell.

Immediately the bearing has been filled the blow-lamp should be turned on the top of the metal to keep it just molten until it is seen to sink down slightly, when there should be as much more metal poured on as is possible without it running over. The result of this treatment will be a smooth casting.

When filling a bearing in an upright position it is much better to cast the metal a little above the bearing itself, so that the shrinkage shall take place in the metal to be cut off, and not in the metal which is to remain in the bearing.

Jigs.

By the use of suitable jigs the operation of pouring can be greatly facilitated. A jig which can be used for various sizes of bearings is shown in Fig. 4. The mandrils should be pieces of steel tube 1-16 in thick or less, and the side pieces should be of steel plate not more than ⅛ in. thick; in fact, the parts of a jig should always be kept down to this thickness if possible, as they can be heated up more quickly and cooled sooner. It is, of course, necessary to lay something in the mandril to keep it in place. The moveable bar shown underneath the mandril is tapped to receive a set screw, to be used for holding a piece of asbestos, backed by a piece of metal against the bearing to stop holes. With a jig of this type a clean casting can be made if the top of the metal has the blow-lamp turned on to it as described above.

Another way when there are no holes in the bottom of the shell is to apply a piece of cold wet sponge or cotton waste underneath the bearing immediately after pouring. This causes the metal to settle down quickly, and the top, before it has time to cool, is able to follow the shrinkage of the metal underneath.

If the operation of lining the shell is successful the next point is to get a working surface on the bearing. In the case of half bearings these can be faced off true, so that the two faces join correctly, and then bored a correct fit for the shaft. To do this properly requires the very best machinery and methods to produce perfectly true surfaces on the bearing. Jigs for machining purposes should always be made where there are a sufficient number of bearings to justify it, and this is a strong argument in favour of sticking to one class of motor for similar duties.

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*Read before West of Scotland Branch of Association of Mining Electrical Engineers.

Ball-Bearings

One of the principal aims in the designs of a bearing is to reduce the friction to the lowest possible amount. Ball bearings fulfil this condition better perhaps than any other type, but have certain disadvantages; they must be threaded on the shaft, and in the case of one intermediate bearing becoming destroyed, a stoppage for some considerable time results. They cannot be repaired on the site, but must be replaced by a new set obtained from the manufacturers. However, there is a growing demand for them for all classes of machinery because of their free-running properties and the small amount of attention required to maintain them. A ball-bearing must fulfil the following requirements:—The races must be continuous; it must be capable of withstanding axial as well as radial load; it must not offer any resistance to shaft flexure; and it must be so designed that the load is sustained by the maximum number of balls.

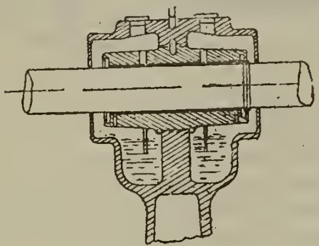

FIG. 5.

Ball-bearings do not allow for end play on the shaft; it is therefore important that only one bearing on the same shaft should be fixed against end play. If the two or more on the same shaft were fixed, the variation in length of the shaft at different temperatures would set up severe stresses. The outer ring of the bearing should be free to move endwise in its housing. Properly installed ball-bearings require very little attention, and very little oil, but they should not be allowed to run dry. Care should be taken to keep moisture, dirt and grit out of the bearing. A ball-bearing should not be allowed to run hot, as that is a sure sign that something serious is wrong; no amount of lubrication will prevent heating if it is due to overloading, inattention, or ignorance of operating conditions.

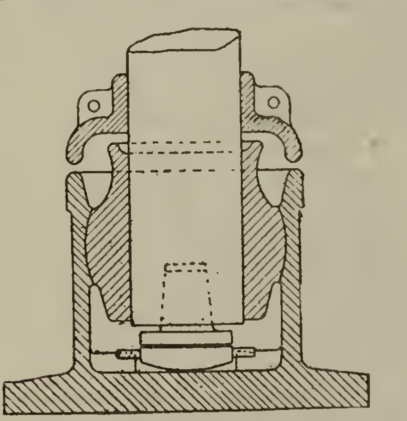

FIG. 8.

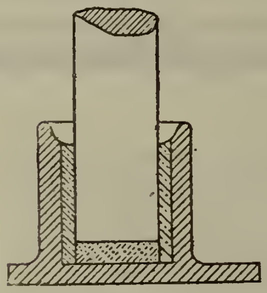

FIG. 6.

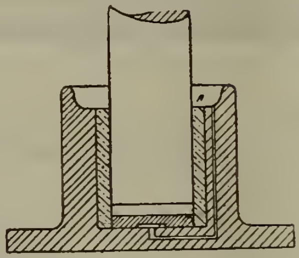

FIG. 7.

Plummer Blocks

Having decided on the form of bearing, we must provide it with a support. A common and perhaps the simplest method, is shown in Fig. 2. While this is suitable for slow-running machines and rigid shafts, it is not suitable for every case. For example, in the case of a shaft supported at each end by rigid bearings, a very small amount of spring will cause the shape to bear on the edge of the bearings and thereby set up a very intense pressure. This can be readily avoided by adopting a proper design of housing (Fig. 5). At first the ball and socket seat was adopted for this purpose, and it is still used to a certain extent, but for the small limits of deflection and the higher speeds used in electrical apparatus a simple arrangement is used as shown. An annular ring is turned in the centre of the bearing shell for about one-fifth of its length, and rests upon a corresponding support in the housing: the bearing ring extends down the sides of the support to take the thrust due to end play. This type is termed self-aligning.

Thrust Bearings

In this case the weight or thrust is generally supported on a flat surface (Fig. 6); if this surface revolves, the speed of a point on the outside edge will be greater than that at a point very near the centre. On account of this difference in speed, the wear on the end surface of the bearing will be very uneven, the outer parts of the bearing surface wearing most rapidly. This increases the pressure at the centre, which may rise sufficiently high to exceed the crushing strength of the material. The unequal wear of the surface of thrust bearings is one of the most difficult problems met with by the designer.

Fig. 7 shows a thrust bearing suitable for light duty. The metal at the centre of the shaft has been removed, thus avoiding intense pressure at the centre, so that the oil which is drawn in at the bottom, is thrown outward by centrifugal force, finds its way into the chamber A, and finally returns through the channel to the centre of the bearing. For heavier work a bearing having a number of discs or washers placed between the shaft and bearing plate is more suitable. The wearing surfaces are increased and the speed of the plates is much lower than that of the shaft. A hole is usually drilled through the centre of the washers.

Fig. 8 shows an improved type of bearing, and is recommended in cases where the shaft and bearing box cannot align with one another. This is one of the cases where ball races can be used to advantage, ball-thrust bearing giving great satisfaction.

The class of machinery on which a bearing is used governs its life, more wear being allowed on some than on others. The wear on motor and dynamo bushes is limited by armature clearance; and in spindles carrying spur gear by the noise and vibrations set up due to the slack bearings allowing the wheels to get slightly out of centres.

Use Of Gauges

It is an excellent plan to make gauges for important bearings, especially those for the first power. By their use the amount of wear can be accurately measured, and, if desired, noted and kept for future reference. Further, they form an accurate and handy tool for aligning the shaft after a new set of bushes have been put in. They are made of 3/8 in. or 1-16 in. rod tapered at each

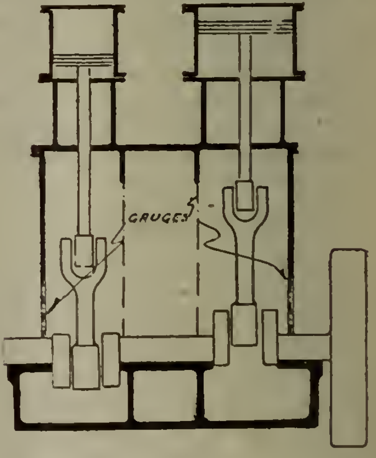

FIG. 9.

end to a point 1-16 in. dia. A centre dab having been punched in a rigid part of the frame in line with the edge of the bearing and at the same time in the line of wear of the bearing, one end of the gauge is placed in this point the other end fitted until it is 4-1000 clear of the shaft. The gauge and dab have corresponding marks typed on them for future reference. Of course, these gauges should be made after the engine has been run and everything found correct. Aligning the shaft after re-bushing is an easy matter and there is practically no fear of springing the shaft. The dotted lines in Fig. 9 show the positions of the gauges on a high-speed engine.

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POWER DEVELOPEMENT AT DOG LAKE

THE city council of Port Arthur, Ont., decided on Nov. 28 to submit a by-law at the January elections to find if the electors want the Hydro-electric Commission to develop, construct and acquire some 30,000 horse-power for the city, probably at Dog Lake. The city at present consumes about 30,000 horse-power, which is secured from Current River, and about 2,300 horse-power, which is secured through the Hydro-electric Commission from the Kaministiquia Power Co. of Fort William. The influx of new industries and elevators into the city will increase the consumption by several thousand horse-power in the immediate future, and in the event of the Kaministiquia Power Co. not being able to supply this from its present plant, another source of power is necessary.

For years this city has been striving to have Dog Lake developed by the Hydro-electric Commission, and it is expected that the vote will be unanimous in favor of it, especially as it will prevent the developement of this power by private interests. There is a probability that the city of Fort William may vote on the same by-law and eventually become a partner in the plant if installed, in proportion to the amount of power consumed. The sister city at present has a contract with the Kaministiquia Power Co. which does not expire for several years. The proposed plant is estimated to cost several million dollars.

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WESTERN CANADA POWER CO.

ONE of the most important requirements of British Columbia in general, and of Vancouver in particular, is the supply of power in the form of electrical energy to the industrial, commercial and agricultural communities. One of the factors in such service is the Western Canada Power Co., which has its hydro-electric plant at Stave Falls, on Stave River, thirty-five miles east of Vancouver, and reached by the C. P. R. main line at Ruskin, where transfer is made to the company's own railway, which runs a daily service between Ruskin and the plant at Stave Falls, six miles north of Ruskin.

From the plant the high tension transmission lines carrying 60,000 volts radiate southward to the international boundary line at Sumas, eastward as far as the Nicomen rock quarries of the C. P. R., and westward to Vancouver city, taking in the cities of Port Coquitlam, Port Moody and New Westminster and the territory included in the municipalities of Mission, Maple Ridge, Pitt Meadows, Coquitlam and Burnaby.

Traversing this same area are two Canadian transcontinental railway lines, two trunk line American railways and a third Canadian line which will eventually connect up with a transcontinental line. Serving this Lower Mainland section of British Columbia, as it is sometimes called, are the salt and fresh waterways which provide unexcelled transportation facilities for those districts and cities.

In connection with this development are three dams—the storage dam, the sluice dam, which will ultimately be made into a solid dam, and the Blind Slough dam. The foundations of the power house are of solid concrete construction, and the superstructure is of steel and reinforced concrete. The building, which is at present 100 feet wide and 90 feet long, is being extended to cover the turbine and generator of the third unit, which is now being set in place, and will be ready for generating power at an early date.

Power Plant

In the power house are installed at present two 10,000 k.v.a. 3-phase, 60-cycle, 4,400-volt generators, built by the Canadian General Electric Co., driven by two 13,000 horse-power Francis type turbines, built by the Escher Wyss Co. of Zurich, Switzerland. Excitation is provided by two 250 k.w. 125-volt generators, each driven by its own turbine, and each capable of exciting four machines. Governors and oil pumps were also provided by the Escher Wyss Co., the pumps being driven by individual wheels of the impulse type.

Six single-phase transformers of 3,000 k.w. capacity each are located on the main floor, each in its own concrete vault with a steel hatch as a top. A travelling crane of 70 tons capacity spans the entire main floor, placing the transformers as well as the generators and wheels directly under the crane. The control switchboard is in a gallery at the east end of the building, giving the operator full view of every piece of moving machinery. All switches are solenoid operated, and, with the fuses, are located in reinforced concrete cells in a concrete lean-to parallel to the main building. The third unit consists of the same type and size turbine and generator as the two at present installed.

British Columbians are hopeful that the industrial activity already begun will continue to increase. Much hope is entertained that the mining industry will be firmly established on a permanent basis. Western Canada Power Co. of Vancouver is in receipt of many inquiries regarding copper refining furnaces, and regarding the treatment of zinc ores by electricity. The establishment of reduction works anywhere in the vicinity of Burrard Inlet or the Fraser River would certainly lead to great activity, and be the means of permanent employment to thousands.

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FIELD OF THE DIESEL ENGINE

THE Diesel engine has a fairly well defined field in which it will have no competitor when its merits are known and appreciated, says S. B. Daugherty in a paper before the A.S.M.E. in Chicago. This is the relatively small plant which, when steam operated, is usually inefficient. In generating electric current for a small town, savings are effected that would justify the installation of the Diesel engine if the cost were two or three times what it actually is. For instance, a 300-h.p. engine is effecting a saving of $1,000 per month in fuel. In another case a 60-h.p. is saving $2,500 a year. In ice-making the cost of fuel per ton of ice with oil at 3 cents per gallon is around 18 to 20 cents per ton of ice produced. This includes driving all the auxiliaries, lighting the plant, etc

For pumping, the combination of an oil engine with a geared power pump makes a pumping unit that has a higher thermal efficiency than the best crank-and-flywheel pumping engine ever built, and this efficiency can be obtained when the oil engine is only 65 h.p., compared with hundreds of horse-power in the steam-driven pump. This means that in parts of the country where oil is used under boilers, oil-engine-driven pumps in small units are pumping water cheaper than is done by the largest steam-driven pumps. Of course, where heat units in coal can be purchased cheaper than heat units in oil, this advantage of the higher efficiency of the oil engine is offset, but it is probable that there is no place where the power requirements for pumping are around 50 to 60 h.p. that an oil-engine-driven pump would not be the most economical, all things considered.

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The genius of the mechanical engineer has cheapened manipulations in the foundry and machine shop; that of the metallurgist, the materials used and produced.

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SENTIMENT NO FACTOR IN POST-WAR TRADE

TO buy in the best and cheapest markets, and sell to the best advantage in the same or other markets are sound business principles. Expediency and disability have, however, to be reckoned with, and, relative to our Dominion, the necessary upbuilding of a sound industrial fabric on the one hand, the lack of a merchant marine and in some considerable degree the lack of knowledge of outside requirements and possibilities on the other, militate against practical exposition of such a propaganda either whole or in part. During the past two years, numerous happenings in the prosecution of the war have made stirring appeals to sentiment, with the result that not a few hastily conceived schemes have been publicly suggested and launched concerning future trade relations with our meantime enemies. In a word, the commercial enterprise of the latter was to be circumscribed and restricted, if not altogether eliminated as a world factor. That such an undertaking was too stupendous,—a sheer impossibility fits better, perhaps, because impracticable—has come to be realized, however.

Is a trade war, following that of blood and destruction, inevitable? In some quarters such a contingency is not anticipated, being even flouted. Why, may we ask, shouldn't a trade war be the logical outcome of the other? The world owes neither of the meantime fighting nor neutral nations, in their individuality as such, a living, nor, in the enlarged sense a progressive development. They each owe it to themselves and to the world to shoulder the relative responsibility, and, as in the past, considerable effort will be expended in demonstrating the fact that such is their attitude. War as practised on the battlefields of Europe and on the sea may be hell, yet only does it differ from trade war in absence of harrowing episode and detail, although even these may be evidenced in lesser or greater degree.

Germany, we may rest assured, is going to have and take a place in the Sun following the war of blood, and her intensity of application to the furtherance of her object is likely to be less dependent on peace term detail than we are prone to imagine. Whether the war has had the like revivifying, yes and revolutionizing effect on her industrial and commercial enterprise as it has had in these directions on the other nations—warring and neutral, we are not in a position to say; this much may, however, be said, that preceding the war, Germany was in many respects an easy leader. We are inclined to think that her pre-war advantage is at least eliminated, and that little evidence of any individual nation monopoly meantime exists.

While Canada, on account of the war, may not have developed a manufacturing capacity to entitle her to rank as a world power, she has made much of the opportunity afforded, and relatively as regards manufactured products her record will bear the keenest comparison. She has nevertheless lagged in industrial and scientific research, in a word, the utilization of waste products and hitherto unused natural resources, the development of new processes—mechanical, electrical, chemical and metallurgical, have been given little attention, and therefore have found but meagre practical application. The establishment of an Advisory Council on Industrial and Scientific Research is announced, and although unnecessarily tardy of creation, may be accepted as "better late than never." Our Minister of Trade and Commerce, Sir George F[illegible]ter, has been so busy gallivanting, and between times twitting our manufacturers in gallery orations with "being asleep"—even "soundly asleep,"' when opportunities were knocking at their door, as to allow two and a quarter years to elapse before realizing what were his own responsibilities and duties as well as those of his Cabinet associates.

Much is looked for from the work of this newly appointed Advisory Research Board, even in the making-up of the lost leeway. Our manufacturers are better equipped to make use of both the data and materials available than they are apt to get credit for, and it may not be assuming too much to observe that they will be called upon to both measure up to and successfully overcome the industrial competition of well-nigh a full hand of pre-war German equivalents, quite some considerable time before much research data becomes available. Our metal-working plants in munitions production constituted themselves into research boards and made good. Nothing succeeds like success, and when the pressure of competition begins to be felt in other than war-commodity manufactures, we shall be surprised if history does not repeat itself.

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PAPER STILL SKY-ROCKETING

JUDGING by the action of the International Paper Co. in the United States, which controls over 50 per cent. of the newsprint paper supply there, the cost peak to consumers is still tending towards higher levels. While a more or less substantial advance had been anticipated, effective with the opening of the New Year, publishers were scarcely prepared for an increase from $2.15 to $3.10 per hundred, f.o.b. mill on renewal contracts. In every branch of the publishing business the effects of paper shortage and paper cost are much in evidence, the outstanding features being fewer and smaller page issues and increased subscription rates. Just how much more the paper manufacturers' cost to consumer will affect space, quantity and cost to readers is somewhat problematical. It may be that a higher value appreciation of "printers' ink" will be cultivated and developed by and through those among whom its distribution has in the past appeared more or less commonplace.

The Operators' Point of View

INSTALLATION OF HIGH SPEED MACHINERY

By J. A. M'Lay.

THE writer was recently engaged investigating troubles which had developed with high-speed machinery, principally turbine pumps, after the machines have been installed and set to work. These investigations have been very interesting, and in most cases it has been found that the troubles have been due entirely to defective installation, or to errors in starting up. The object of the writer is to indicate as far as possible in the compass of a short paper, the precautions which ought to be taken to avoid these troubles.

The points which decide the satisfactory working of any high-speed machine are:—(1)—Foundations and grouting-up; (2) Level and alignment; (3) Coupling; (4) Connections. Standard high-speed machines, such as turbine pumps, fans, motors, etc., are designed to be mounted on solid foundations of concrete, brickwork, masonry, or steel construction. They should not be set up on temporary foundations, such as timber, without first consulting the makers. There are cases, of course, where, owing to a breakdown, it is necessary to mount such a machine on temporary foundations; but, if this has to be done, every precaution must be taken to ensure that the bedplate is properly supported, and that, as soon as possible, the machine will be laid on its proper foundations.

Multi-Stage Turbine Pump Installation

It will be interesting to take as a concrete example a high-speed motor-driven, high-lift multi-stage turbine pump, such as is now very commonly used for unwatering mines and collieries, the pump and motor being direct coupled and mounted on a common bedplate. After the foundation block has been installed to the maker's requirements and allowed to stand for a few days to set, the first thing to do is to lay the bedplate down and level it. Care should be taken to make sure that the bedplate is supported by wedges every few inches, and not at a few points only; if this is not done, the machines will almost certainly get out of alignment, the plant will be given an endless amount of trouble with hot bearings, and the job will thus have to be done all over again. The bedplate should be grouted-up with the holding-down bolts in position, and it will improve the job if the inside of bedplate is run up solid with the grouting.

After allowing a few days for the grouting to set, the holding-down bolts may be screwed down. The bedplate should then be checked, and if everything is found correct as to level and height, the motor and pump may be fixed in their places. Exception may be taken to some of the precautions suggested on the ground that the bedplate is of a stiff section, and can accordingly be trusted to take weight without warping, even though it is not supported every few inches. This is a mistake. The manufacturer supplies a bedplate of ample depth and strength to support the weight put upon it, but he cannot make one which will resist the efforts of a determined man with a spanner and a piece of pipe who makes up his mind to see that the holding-down bolts are solid. The writer has seen a man twist the bedplate of a 3,000-kw. turbine, although it was of box-section, 18 in. deep. It is necessary to make quite sure that the pump and motor are in line and correct for level, which, as will be shown later, does not necessarily mean for height. This depends to a large extent on the type of coupling and on the way in which the halves of the coupling have been fitted.

The Coupling Feature

As the type of coupling is of considerable importance it may be well to digress for a little and note one or two points about it. Flexible couplings are generally fitted to direct-coupled high-speed machines, but the word is a misnomer. These couplings, as a rule, will take care of a slight endway motion, and are fitted to prevent an end thrust being thrown on to the pump from the motor, or vice versa. They will not take care of any out-of-alignment without at the same time setting up what may, in the end, be worse troubles. A solid coupling with fitted bolts makes the best job, as it ensures care in erection, but such a coupling cannot always be fitted owing to the need for a little end-play on the rotor of a motor.

Of the many different kinds of flexible couplings, the writer prefers the "pin" type, in which the bolts are fixed in one-half while in the other half they are fitted with rubber or leather washers or collars working in clearance holes. Such a coupling is quite satisfactory provided the halves have been properly secured to the respective spindles, and turned up over the rim and on the face along with the spindle. With such a coupling it is always a very simple matter to check the alignment of two spindles by measuring between the faces with feelers, and also to check the heights with the help of a straight-edge placed along the rims of the two halves of the coupling. When doing so it is important to take out the coupling bolts and rotate one-half of the coupling, checking in two or three different positions.

Motor and Pump Relative Heights

The next point to be considered is the relative height of the motor and pump. At first sight it would look as if it would be proper to have the pump and motor placed dead level, but that depends on the working conditions. In the case of a pump for hot water and running continuously it may be advisable to have them placed dead level as the expansion of the motor frame due to heating will be equalled by the expansion of the pump casing due to the hot water. As a general rule, however, in colliery work—apart from boiler-feed pumps handling hot water, or pumps running very intermittently, it is advisable to set the motor a few thousandths of an inch lower than the pump or other machine it may be driving, so that, when the motor gets heated up to its working heat, the two spindles are dead level and at the same height. This will not apply if the motor is fitted with pedestal-type bearings carried independently of the motor frame. In such a case the two machines may be set at exactly the same height when cold. The pump and motor being set properly in line and at the correct height and level relative to each other, they may be bolted down and the dowel-pins driven in, after which they should be checked again with the coupling.

Dowel Pin Features

A word may be said concerning dowel-pins. Some manufacturers do not fit these, even for high speed machinery, unless they are specifically called for by the purchaser. This cannot be described as good practice, as without them the labor involved in resetting after an overhaul costs much more than the fitting of the dowel-pins in the first instance. More might be said about the type of pins used by most manufacturers—viz., the type which can be driven in, but can only be withdrawn by destroying the pin. Dowel-pins ought to be screwed at the upper end and fitted with a nut by means of which it can easily be withdrawn. After the pump and motor have been set up on the bedplate, all the care exercised can easily be negatived if equal care is not observed in connecting the pipes to the pump. This applies with special force if the pump is to deliver a relatively large volume against a small head. In the case of a steam turbine, which is relatively a substantial and strongly built machine, the makers always insist on special precautions being taken with the steampipes to ensure that no weight or thrust from the pipes is carried by the turbine.

Pipe Connections

It is advisable in all cases to begin the fixing of piping at the pump itself and work away from it. Never spring a badly fitting pipe on to a pump, for that is responsible for much trouble. The flange may break off or distortion may be caused, which will mean bearing trouble and perhaps internal fouling. Do not hang the weight of piping and valves on the pump; the casing is not designed to carry them, and if the weight is put on trouble will ensue. The same remark applies to all kinds of machines, especially when they only form part of a completed whole. Each part should be made to stand on its own feet and support itself. Neglect of this fact is a most fruitful source of trouble. Colliery engineers are not the only sinners in this respect, as sometimes large firms of contractors make the worst blunders.

Erection being completed, the oil-wells should be thoroughly cleaned out with paraffin oil or naptha, and the oil-rings examined to see that they are free to revolve and have no rough edges. After the oil-wells have been filled with a suitable lubricating oil, the motor may be started to check the speed and direction of rotation. It is necessary to check the rotor clearances, to see that the brush gear and brushes are fitted correctly to test the insulation, and to make sure that the earth connections are coupled up. If everything is correct in these respects, the coupling bolts may now be inserted and made secure.

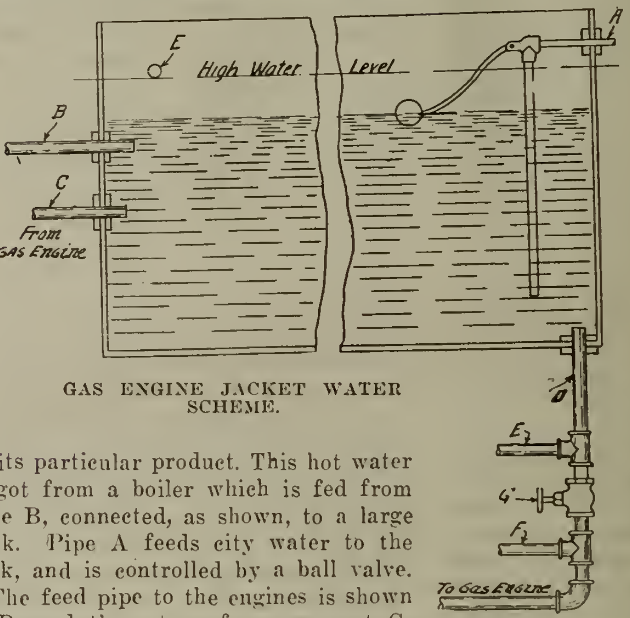
The sheet of instructions sent out by the maker of the machine which the motor is driving should be studied carefully, and all the instructions given thereon attended to, for they are the results of experience, and the makers may be presumed to know best what their machine requires in the way of attention. Having done this the plant may be put to work with the knowledge that everything has been done necessary to ensure a fair chance for it. In conclusion, the electrician should satisfy himself before leaving the plant that the men in charge of it have also studied the maker's book of instructions, and that they faithfully carry out these instructions every time they have to start or stop the plant.—From a paper read before the Yorkshire Branch of the Association of Mining Electrical Engineers.

* * *

GAS ENGINE JACKET WATER SCHEME

By J. Thorn.

THE arrangement here shown is installed in a plant employing gas engines for power purposes, while at the same time requiring large quantities of hot water, summer and winter, in the manufacture of its particular product. This hot water is got from a boiler which is fed from pipe B, connected, as shown, to a large tank. Pipe A feeds city water to the tank, and is controlled by a ball valve.



GAS ENGINE JACKET WATER SCHEME.

The feed pipe to the engines is shown at D, and the return from same at C. The overflow from the tank is at E.

By this scheme all the heat passing through the walls of the gas engine cylinders is transmitted to the water in the tank. If no water is being drawn off through pipe B, there is enough water margin in the tank to supply the gas engines for some considerable time before the content gets too warm to affect seriously the cylinder cooling. A small belt-driven pump is connected to the systems by pipes E and F, so that should the gravity circulation prove too slow at any time when the water is not at a low temperature, the valve G can be closed and the water driven through the jackets as rapidly as desired.

* * *

A NEW METHOD OF REFRIGERATION

IN a recent issue of the *Scientific American*, N. H. Easton describes in detail a new method of refrigeration. The common present practice is to employ an easily compressible gas, such as ammonia, carbon dioxide, or sulphur dioxide, liquefy it under pressure, and, after cooling, allow it to vaporize under reduced pressure. The heat for this vaporization is absorbed from the surrounding medium, usually brine, which becomes very cold and is used as the actual refrigerant.

The newly developed system of refrigeration differs radically, however, from this by using neither a gas nor high pressures, producing low temperatures solely through the evaporation of water. The process, it may be said, is far from novel, being in fact a reversion to ancient principles, for the earliest known method of cooling water is to place it in a porous vessel set in a draught of air. Small portions ooze through the pores, and, in evaporating at the outer surface, draw heat from the water that is left and reduce its temperature. Only one improvement is introduced in the new system—the water is evaporated in a partial vacuum instead of at atmospheric pressure.

At a pressure of 14.7 pounds per sq. in., water boils at 212 degs. F., but it boils at 45 degs. F. under a pressure of .147 pounds, and, at 32 degs. F., under a pressure of .0886 pounds. Thus, by reducing the pressure, the rate of evaporation and consequently the rate of cooling, can be greatly increased. A number of attempts have been made in the past to apply this well-known principle, but they have all failed for want of a suitable air pump that would maintain a sufficiently reduced pressure continuously. The success of the new system rests on the centrifugal air pump invented several years ago by Maurice Leblanc, and which is described later.

Briefly, the operation of this refrigerating machine is as follows: Brine is drawn from a reservoir into a large vessel, called the evaporator. At the top of the evaporator the brine passes through a perforated plate and falls as a fine spray. The pressure within the evaporator is maintained at a low point so that a large part of the spray evaporates at ordinary room temperatures. The heat for this evaporation is drawn from that part of the spray remaining liquid so that the brine that collects at the bottom of the evaporator is very cold. This is pumped out and distributed to make ice or for other refrigerating purposes, and is returned finally to the brine reservoir to go through the cycle again.

It is obvious that the water vapor formed in the evaporator must be removed or the pressure would rise and stop the process. This removal is effected by means of a steam jet of high velocity, which sweeps the vapors out of the evaporator into a condenser (of either the jet or surface type), where everything is condensed and removed by a pump. A study of the diagram, Fig. 1, will make clear the details. The type of machine shown, with a single steam jet, does not reduce the temperature of the "brine" (in this case merely pure water) below 32 degs. F., and is used mainly for cooling water or air. Where temperatures lower than this are required, as for ice making, two steam jets in series are used and the brine employed is an actual salt solution.

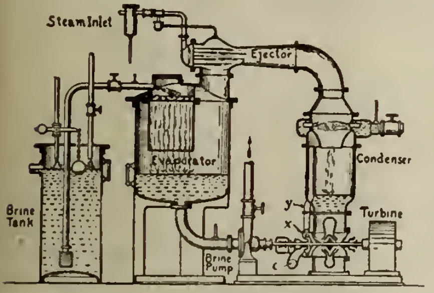


FIG. 1.

The air pump, which is shown at X in Fig. 1, and is enlarged in Fig. 2, has to maintain low pressure throughout the whole system against leakage and the tendency of the steam jet to raise it. From Fig. 2 it will be seen that this pump consists of a rotating impeller, A, which runs within a casing similar to that of a centrifugal pump. This impeller draws water into the chamber B through inlet C and forces it out through cone D in a series of layers or pistons. Between these water pistons layers of air are imprisoned from inlet Y, thus reproducing the action of the mercury pump, the most effective pump we possess.

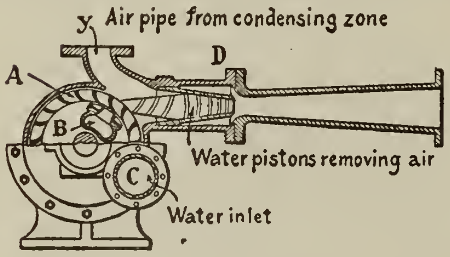


FIG. 2.

One of the obvious advantages of this type of machine is the elimination of a dangerous gas carried at high pressure. Explosions of ammonia or carbon dioxide tanks take place occasionally, and not only cause great damage, but make rescue work very difficult. For vessels, and especially warships, this point is of great importance. If a tank containing gas at 600 pounds per square inch pressure is struck by a projectile, the resulting explosion will cause about as much destruction as a shell. Furthermore, if the supply of gas becomes exhausted for any reason, it might be very difficult under certain circumstances to renew the supply.

IMPROVING A PIPE CONDUIT

By J. Kingston.

A PIPE CONDUIT had brick walls, earth bottom and 2-in. wood top. Considerable heat being lost as a result of this construction, a concrete floor was laid, 3 inches thick, and concrete slabs cast for the top. These slabs were 7 ft. 6 in. wide, and 4 ft. long. A number of old, worn-out bed-springs were used for reinforcing, being placed as at E, Fig. 1, which is a sectional view of conduit, the pipes being supported by 2-in. iron pipe rollers.

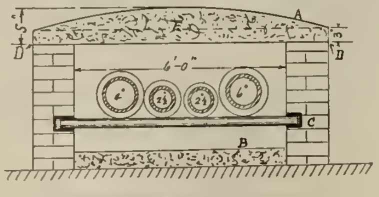


FIG. 1. IMPROVING A PIPE CONDUIT.

The mould made to cast the slabs is shown in Fig. 2. Two end pieces were cut, side pieces nailed on and the bottom of the mould was formed by nailing on strips of wood about 3 in. wide. The concrete was a mixture of gravel, 8 parts, sand, 5 parts, and water enough to form a soft mixture. When the slabs became set they were removed from the moulds and allowed to dry out; they were then placed upon the brick walls.

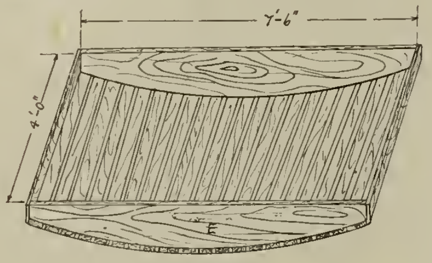


FIG. 2. IMPROVING A PIPE CONDUIT.

Under the ends at D, a generous coating of tar and sand was placed, and the same treatment given the ends E; this made the joints watertight, and if it becomes necessary to get at the pipes, the slabs can be lifted up without injuring them in any way.

The 2 in. iron pipe supports roll in pieces of 3 in. pipe built into the wall as at C. Fig. 1.

* * *

RELATIVE POWER COSTS

By K. A. P.

TWO of the most important considerations affecting the question of purchased power versus that generated locally are the relative costs per k.w.h. and the frequency. The question of price versus the cost of generating power is one which cannot be treated in generalities, each proposition being surrounded by very many special conditions which have an all-important bearing on the decision. However, two points should be emphasized:

First, that extreme care be taken to include all expenses properly chargeable against cost of power when, as is usually the case, the price of purchased power is being compared with an estimated cost of local generation. Second, that while the estimated cost of producing power locally may appear to compare favorably with or be even lower than the price quoted, the public service corporation is a manufacturer and seller of power, while for, say, a steel mill the development of power is somewhat of a side issue, especially in small plants, and only one of the many factors incident to the manufacture of steel products.

The whole effort of the public service company is devoted to improving the service, a large force of engineers being maintained for this purpose, and while theoretically this is possible with, say, a steel mill also, practically it is never the case with small plants. Therefore, extreme care should be exercised before making a decision against purchased power based on an estimated cost of developing power locally, although this may appear to be justified by the figures.

* * *

HOW TO MAKE A LEAD GASKET

By J. E. Noble

MAKE two boxes, one with a bottom as shown in Fig. 1, and one with neither top nor bottom.

Fill box No. 1 with a soft mixture of plaster of Paris and allow it to harden. When the plaster is hard lay on top of it a sheet of oiled paper and on top of the paper, box No. 2 is placed. Have a pattern of the gaskets required, (one of asbestos or rubber will do). Place this on top of the paper at centre of top box and hold the piece of tin or other tube (paper will do) as in Fig. 2. Be

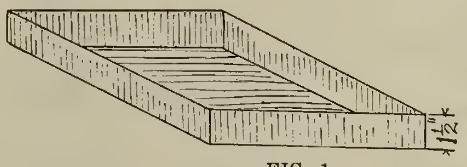


FIG. 1.

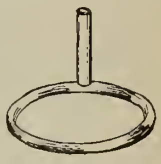


FIG. 2.

sure that both pattern and tube have a thin coating of grease to prevent the plaster of Paris sticking to them.

When the mixture hardens the tube can be removed, the boxes separated and the pattern and oiled paper removed. This will leave a completed mould, good to make as many gaskets as desired.

Pure sheet lead should be used, or guaranteed pig lead; it is not brittle as it would be if tin or antimony, etc., were in it. When a good soft lead is used it can be remelted time after time in recasting other gaskets. A mould can be made for each size gasket required and after the first cost for gaskets and moulds, which is a small item, there will be little more cost as the old lead in the gaskets can be re-used. It requires no mechanical ability or skill to make the moulds or castings and the gaskets will give good satisfaction for steam pressures up to about 100 pounds; they are O.K. for water, gas, etc.

◆

NON-CONTINUOUS HEATING BY EXHAUST STEAM

By N. London.

A FACTORY which operated a steam engine five days and nights per week used the exhaust steam from the engine to heat the manager's house, some three hundred feet distant. During the other two days the fire in the large horizontal return tube boiler was not kept burning, as the heat retained in the factory was sufficient to prevent any freeze-up until the fire was required for steam again.

As the manager required heat seven days per week, he had a small cast iron steam boiler installed in the basement of his house and connected to the exhaust pipe from the engine C and the return pipe to the hot well D. The pipe E should be shown connected the same as pipe F to help take care of the expansion in connection with the cast boiler connections; a check valve was also placed at B.

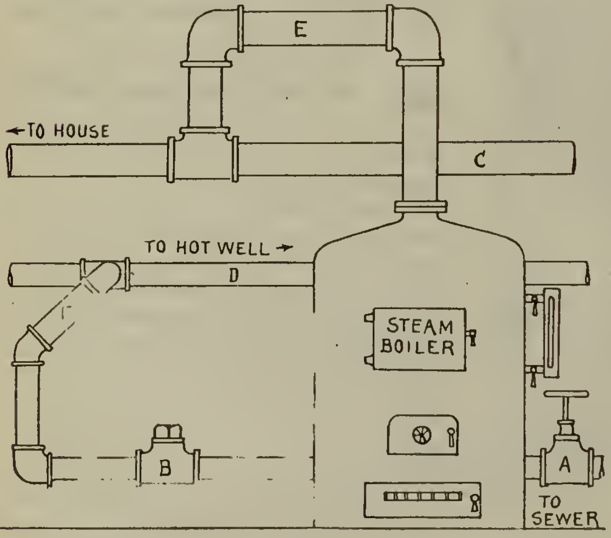


FIG. 3.

During the five days the engine exhaust was being used the small boiler steam space would become filled with condensate, but by opening the valve A it could be emptied to the proper level in a few minutes.

The main and return from the factory to the house was encased in a double box made from 1½ in. plank. The joints on the box were all planed and painted with white lead before being nailed together, as shown in Figs. 1 and 2. The pieces I hold the boards apart 1½ in. C is the exhaust and D the return. The supports for the iron pipe cross pieces are cut apart at A and B. This allows the bottom pipe to be put in place before the upper supports are put in. No filling is placed in the outer or inner spaces of the box, very little heat being lost by radiation with a box of this description

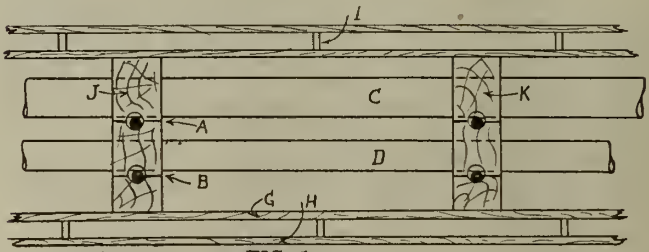


FIG. 1.

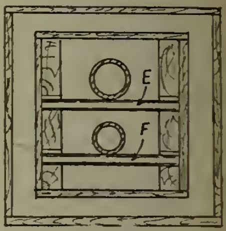


FIG. 2.

◆

JOINT EFFICIENCY

By N. G. Near.

I AM asked, "What is the difference in efficiency between joints Figs. 1 and 2.

If it is a double cover butt boiler joint, with correctly spaced distances between horizontal rows of rivets, and with all other conditions—pitch, rivet diameters, etc. — the same, there is no difference in efficiency. The staggered arrangement is generally preferred in practice, however, because it saves a little metal for covers.

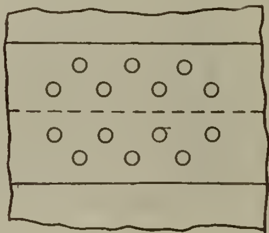


FIG. 1.

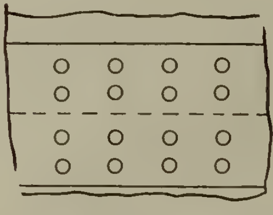


FIG. 2.

If it is a belt joint, however, Fig. 1 outer holes, whereas in Fig. 2, the weakwould be the more efficient due to the fact that there the weakest section would be along the line of the three est section would be through the four outer holes, assuming all holes to be of the same diameter, belts of the same width, etc.

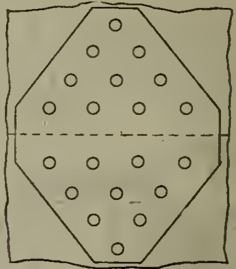


FIG. 3.

By extending the joint width, as shown in Fig. 3, we would have a considerably higher efficiency, the efficiency of which would be, practically,

$$\frac{w - d}{w}$$

where w = width of belt in inches;

d = diameter of punched hole in inches.

It is evident that the approximate efficiency of Fig. 1 would be, then,

$$\frac{w - 3d}{w}$$

and of Fig. 2,

$$\frac{w - 4d}{w}$$

It is common practice to rivet steel tie bars in the manner indicated by Fig. 3 because of the high efficiency of such a joint.

In belting practice, though, this joint is not used as a laced joint because of its bulkiness.

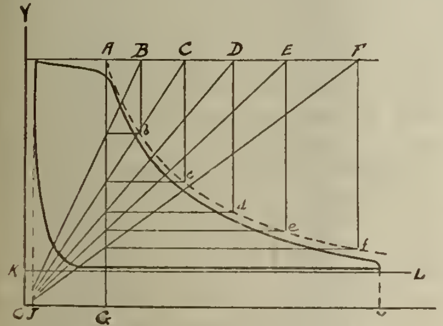
◆

In case-hardening steel articles, the best results are obtained with a temperature of 900 deg. Cent., or 1,652 deg. Fah. The length of time required for the process is between four and six hours, according to the degree of penetration required, the time being taken from the moment that the boxes and contents have acquired the carbonizing temperature.

Operators' Instruction Course

CONCERNING INDICATOR DIAGRAMS—III.

THE expansion line on an indicator card from the point of cut-off to the point of release should be an adiabatic curve, that is a curve which represents neither gain nor loss of heat. As the curves on actual cards never follow this line it is a good plan to draw an adiabatic curve on the indicator card for reference. To draw this curve accurately requires the use of a rather complicated formula, but as it very nearly corresponds to an hyperbola, the latter can be drawn by simple graphical means.



DRAWING EXPANSION CURVES.

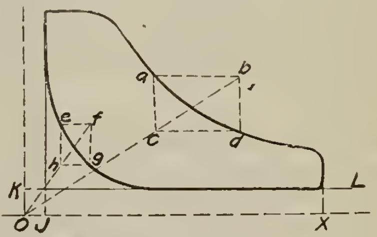
In the diagram shown, the dotted line represents the curve so drawn. The vacuum line OX is drawn at a distance to scale below the atmospheric line KL, corresponding to barometer pressure, practically 14.7 lbs.; OY is the clearance line, and YF is drawn parallel to OX through the point of highest steam pressure shown on the card. Continue the expansion line up until it meets this line at A. Select any number of points B, C, D, E, F; connect each of these to O, and draw the line AG parallel to OY. From the points where the radial lines cross the line AG, draw horizontal lines, and from the points B, C, D, E, F drop vertical lines. Through the points where these two sets of lines meet draw curve b.c.d.e.f. which is an exact hyperbola. The true adiabatic curve is slightly below the hyperbolic curve, but the latter is accurate enough for all practical purposes.

The saturation curve or the relation between pressures and volumes as given in steam tables is also sometimes drawn on an indicator card. Generally this curve will fall between the hyperbola as drawn above and the real expansion line of the indicator card. Instructions for drawing saturation curves by means of steam tables will be given later.

Cylinder Clearance

The clearance in an engine cylinder is usually determined by measuring the volume inside not swept through by the piston. In other words, the length of the inside of the cylinder minus the stroke of the piston times the area of the cylinder gives the clearance volume. The ratio of this volume to the volume of piston displacement is the clearance. However, it is often impossible to measure this clearance exactly, in which case it can be fairly accurately determined from the indicator diagram, the procedure being very nearly the reverse of that given above for drawing expansion curves.

Take a good indicator diagram and lay out the vacuum lines OX parallel to the atmospheric line KL. Take two points (ad) on the expansion line and (eg) on the compression line and draw horizontal and vertical lines through these points, completing the rectangles (abcd) and (efgh). Draw diagonals through these rectangles and the points where they cross the vacuum line at O determines the clearance. The ratio of clearance is OJ divided by JX. In using this method for determining the clearance a number of diagrams should of course be laid out as above and the average result taken.



DETERMINING CLEARANCE FROM DIAGRAM.

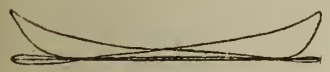


FIG. 1.

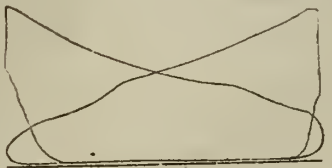


FIG. 2.

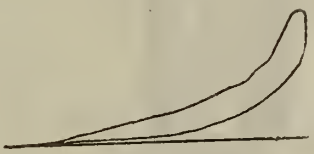


FIG. 3.

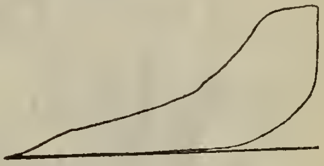


FIG. 4.

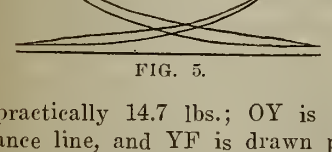


FIG. 5.

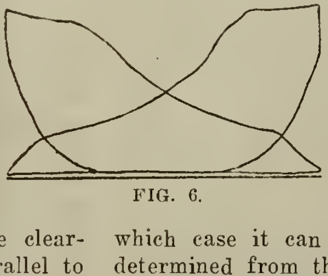


FIG. 6.

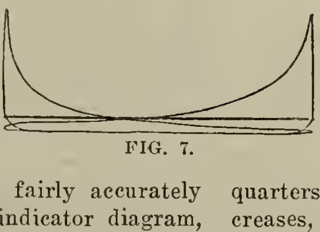


FIG. 7.

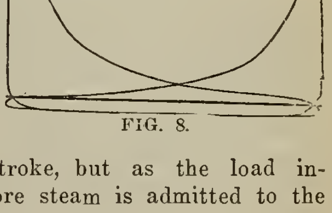


FIG. 8.

Characteristic Diagrams

Single Valve Throttling Engine.—The diagrams Figs. 1 and 2 were taken with the same spring and illustrate very well the action of the governor. Fig. 1 shows a light load and Fig. 2 a heavy load. The point of cut-off always remains at the same point, about three-quarters stroke, but as the load increases, more steam is admitted to the cylinder, and the initial pressure is consequently higher.

Single Valve Automatic Cut-off

Engine.—Figs. 3 and 4 represent respectively light and heavy loads. The initial steam pressure is about the same, and as the load increases, the point of cut-off occurs later in the stroke. Compression becomes later as the cut-off increases. The points of admission and release change also, but not so noticeably as the cut-off and compression.

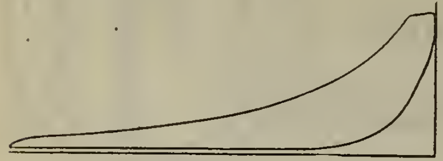
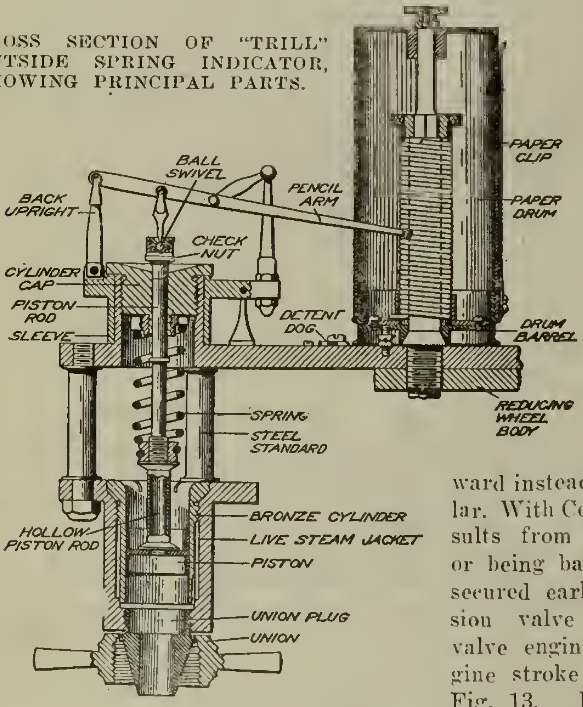


FIG. 9.

High Speed (250-300 r.p.m.) Single Valve Automatic Engine.—The first diagram Fig. 5, shows the "friction load" or work done in overcoming friction in the engine itself. Diagrams for heavier loads, Fig. 6 generally show large compression at the speeds given while the point of cut-off is rarely sharp.

Moderate Speed Corliss Engine.—Fig. 7 represents a load lighter than the most economical and Fig. 8, about normal load. When the valves are in good order there is always a characteristically sharp cut-off, small compression is required because of slow speed and quick admission. The exhaust line being below the atmospheric line demonstrates that the engine is running condensing. The amount of vacuum in pounds on the return stroke is the distance between the exhaust and atmospheric lines measured on a scale corresponding to the spring used in the indicator cylinder.



CROSS SECTION OF "TRILL" OUTSIDE SPRING INDICATOR, SHOWING PRINCIPAL PARTS.

Four Poppet Valve Engine.—Fig. 9 is a characteristic diagram of the most recent type Nordberg poppet valve, non-condensing, 200 r.p.m., engine showing 31.75 m.e.p.

Uniform Engine.—Fig. 10 is a characteristic card from a latest type Nordberg uniflow condensing engine, operating under normal conditions.

Faulty Diagrams

Too Early Admission.—The line **hd**, Fig. 11, slants backward instead of being almost perpendicular. In a single valve engine, the cut-off, release and compression, will also be too early as shown; on the other hand, in a Corliss engine these latter may not be affected.

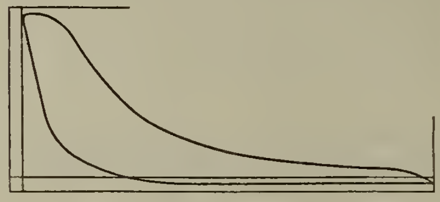


FIG. 10.

In the single valve engine, the eccentric should be moved on the shaft to decrease its angle of advance, while in the Corliss engine, the lap of the admission valve should be increased. When release occurs too early as at **b**, there is loss of mean pressure. The valve should be set so that the drop from the expansion line to the back pressure line is as close as possible to the end of the stroke.

Admission Too Late—The admission line cd, Figs. 12 and 13 slants forward instead of being nearly perpendicular. With Corliss or releasing gears, it results from valves becoming misplaced or being badly set. Admission may be secured earlier by reducing the admission valve laps. With single slide valve engines, other events of the engine stroke are also late as shown in Fig. 13. Release occurs so late, that there is excessive back pressure at the beginning of the return stroke. The valve should be set so that the drop from expansion line to exhaust line is at the end of stroke.

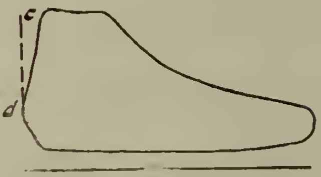


FIG. 12.

* * *

GAS ENGINE GAS CONTROL

THE accompanying sketch shows an arrangement that has recently been patented by the National Gas Engine Co., Ashton-under-Lyne, and S. Travis, to enable gas engines, in which the compression of the mixed charge of fuel and air takes place in the engine cylinder, to operate on gaseous fuel of a low calorific value as well as on gaseous fuel of a higher calorific value without structural alteration or alteration of the compression ratio or inlet valve adjustment. In the arrangement, suitable for a single cylinder engine, there is provided a valve box A having two conduits B and C formed in it, one B connected to an air-supply pipe and the other C to a branched pipe, one branch conveying producer gas and the other exhaust products, coming either from the engine in question or any other engine. Controlling cocks D and E are provided in each of the conduits of the valve box, and a switch cock is provided at the junctions of the branches of the pipe conveying producer gas and exhaust products to the conduit C. Valve seats are formed in the sides of the conduits of the valve box adapted to co-operate with the two discs G and H of a double-beat valve. The conduits are continued through the valve box to the engine cylinder in such a manner as to convey the two working fluids to the engine cylinder on leaving the valve box.

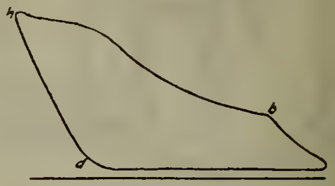


FIG. 11.

Coaxially with the seats formed in the valve box, a cylinder J, having ports K in it, is provided, the ports communicating with a supply of coal gas by way of the conduit L. A piston M having inclined edges is provided adapted to slide in the cylinder, and more or less expose the ports K. The bottom of the cylinder J opens into the conduit C of the valve box, which conveys producer gas or exhaust products. The piston M is adapted to be reciprocated in the cylinder by an extension of the stem of the double-beat valve. The double-beat valve is controlled by a governor through an operating rod O. The piston M which controls the coal gas supply is so attached to the valve stem that the piston can be rotated relatively to the cylinder wall so as to provide an adjustment in consequence of the inclined edges of the piston. The adjusting cocks D, E, in the two conduits of the valve box are situated one above the other coaxially so that their controllin

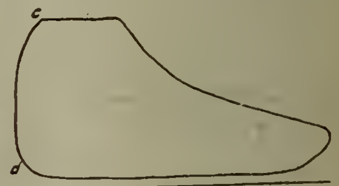
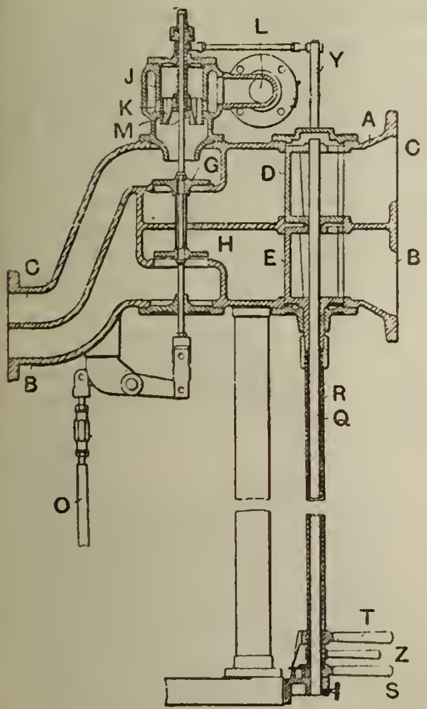


FIG. 13.

spindles Q and R are coaxial. These spindles carry adjusting handles S and T moving over graduated sectors supported on a bracket below the valve box. By a suitable linkage and a spindle Y the angular position of the coal gas controlling piston M may be controlled from a handle Z situated in proximity to the other controlling handles.

In operation, assuming that the engine is running on producer gas, the desired mixture is obtained by setting the cocks D and E in the valve box conduits, and the speed of the engine is controlled by the double-beat valve G, H. It will be understood that the supply of coal gas by way of the conduit L is shut off and the switch cock in the pipe leading to conduit C is set to pass producer gas. When it is desired to run on coal gas, the switch cock is set to pass exhaust products to the conduit C, and the supply of coal gas by way of conduit L is turned on. It is then easy to adjust by means of the handles T, Z, and S the mixture of air, coal, gas, and exhaust products to obtain a mixture having approximately the same calorific value as the mixture previously used of air and producer gas. The valve box A may be so arranged that the various fluids on leaving the double beat and piston valves divide into two or more streams to feed any desired number of cylinders. In the case of a four-crank-tandem engine, a double set of gas and air connections may be provided. In the case of two or three-crank-tandem engines a single set of valves may be employed.



GAS CONTROLLER FOR GAS ENGINES.

ADVISORY COUNCIL ON INDUSTRIAL AND SCIENTIFIC RESEARCH

THE following honorary Advisory Council on Industrial and Scientific Research was on Nov. 30 established by the Canadian Government:—A. Stanley MacKenzie, Ph.D., president of Dalhousie College and University, Halifax; F. D. Adams, Ph.D., D.Sc., Dean of the Faculty of Applied Science, McGill University, Montreal; R. F. Ruttan, M.D., professor of Organic and Biological Chemistry, McGill University, Montreal; J. C. McLennan, Ph.D., University of Toronto; A. B. Macallum, M.B., Sc.D., University of Toronto; Walter C. Murray, LL.D., president of the University of Saskatchewan, Saskatoon; R. Hobson, Steel Company of Canada, Hamilton; R. A. Ross, consulting electrical engineer, Montreal; and Tancrede Bienvenue, general manager of La Banque Provinciale, Montreal.

The appointment of this Council is a forward step designed to stimulate the industrial development of Canada on scientific lines, as has been done already in many countries. The need for such a step was emphasized by Sir George Foster in the House of Commons last session. Since then he has been studying the procedure of other countries and has placed himself in communication with scientific and research experts in various Canadian cities, who have given attention to this question. The Council now appointed will work along the lines already being followed in Great Britain, where the Advisory Council is responsible to a ministerial sub-committee according to a plan proposed by Mr. Arthur Henderson.

The scheme went into operation in Great Britain in July, 1915, after which a proposal was made that its scope be extended to the overseas Dominions, a proposal which was adopted in principle.

Universities' Co-operation

In January of this year circulars from the Minister of Munitions were sent to universities in Great Britain and Canada inviting co-operation in the improvement of appliances for land warfare. The universities have supplied information as to their facilities for research work and have expressed their willingness to co-operate with some branch of the Dominion Government.

Sir George Foster has recommended, and there has been appointed, a sub-committee of Council, consisting of himself and the Ministers of Interior, Mines, Inland Revenue, Labor and Agriculture to work with the Advisory Council. Their duties are to secure the co-operation of other bodies in the work of scientific and industrial research. The most practical and pressing problems presented by industrial necessities will be directed by the committee to the research bodies for solution. Reports will be made from time to time on the results of the investigations.

The practical necessities to be dealt with are the utilization of waste products, the discovery of new processes, mechanical, chemical and metallurgical, and the development of the unused natural resources of the country into useful adjuncts of industry. The importance of the step now being taken has been specially evident under war conditions when the scarcity of certain compounds and processes has caused confusion and paralysis in industries, and has added greatly to the cost of living.

In addition to the facilities offered by the universities of Canada, private, corporate and government laboratories are more or less engaged in research work. The Manufacturers' Associations also have signified their desire to co-operate in the research work in relation to the industries of the country. The new committee will of necessity travel about in carrying on their work.

* * *

A SELF-LUBRICATING METAL

A SELF-LUBRICATING metal is reported to have been produced in the United States, in which the mechanical strength of graphite is increased by impregnating it with a metal. The mixture is called "Graphalloy," and is not injured by contact with oil; in fact, oil can be used along with it. The manufacture of the alloy is described in the "Scientific American." The graphite is placed in a crucible of the same material, together with the molten metal, with which it is to be impregnated. The crucible is then placed in the cylinder of a large press, and a partial vacuum created simultaneously with the application of heat. Upon the completion of this operation, high-pressure air is admitted to the cylinder of the press. The plunger of the press on which rests the crucible is also forced up by hydraulic pressure. After impregnation, the graphite is found to have absorbed metal enough to increase its original weight by 150 per cent. For bearing purposes the alloy used is babbitt.

* * *

AT one time there were twenty-five separate electric power generating stations in Chicago under many different managements. But the result of centralization has been a saving in coal, in the cost per kilowatt, in operating costs, and in the charges to the consumer. The characteristics of the peak load have also changed, and the maximum railway load is now about three times that of the lighting output. Larger units are likely in the future; 30,000-kilowatt units will be installed next year, and larger ones the year after; higher steam pressures are also likely, and are being used experimentally at the present moment to some extent.

Steam Power Plant Auxiliaries

STEAM TRAPS—V.

THE Sarco trap is another example of the thermostatic type and is characterized by great compactness and simplicity. The interior construction is illustrated in Fig. 27, from which it will be observed that the device consists of a steam pipe body which can be screwed on anywhere in a steam main or pipe, taking the place of an elbow or bend, in the upper end of which is secured a tubular piece termed a cartridge. This cartridge is hermetically sealed both top and bottom, the top end being threaded and adjustable in the body, while the lower end is made so as to allow the valve stem to project upward inside of a spirally corrugated tube, the lower end of this tube being secured to the lower end of the cartridge. The upper end of the valve spindle is fastened to the cover which closes the upper end of the corrugated tube and the space between the cartridge tube and the corrugated tube is filled with an expansible fluid. Under the influence of heat, this fluid expands and its increase in volume causes the corrugated tube to contract in length so that the valve spindle is moved downwards and seats the valve when the temperature reaches that of steam. When water collects and surrounds the cartridge, the reduced temperature causes the liquid to contract and allow the corrugated tube to extend upwards again, opening the valve and repeating the sequence of operations indefinitely.

This trap is made by the Sarco Engineering Co., New York, and is built in a variety of sizes suited for general work, as well as low pressure, vapor and vacuum heating systems.

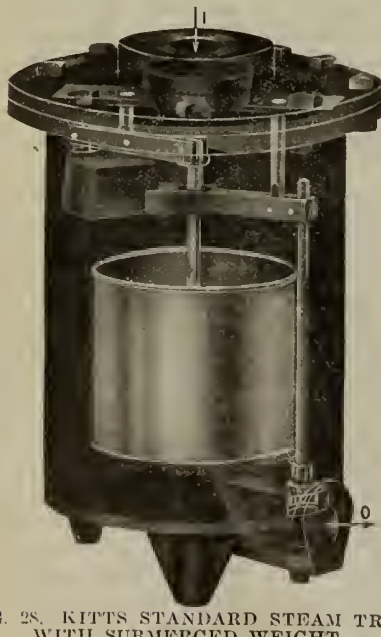


FIG. 28. KITTS STANDARD STEAM TRAP WITH SUBMERGED WEIGHT.

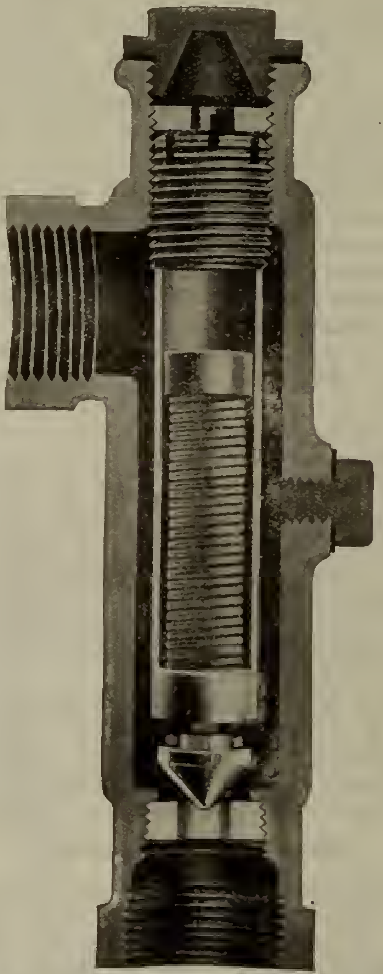


FIG. 27. SECTION OF SARCO TRAP SHOWING CARTRIDGE AND SPIRAL TUBE.

Kitts Standard Steam Trap

The principle involved in the operation of this trap is that of the change in weight of a body when immersed in water. The transparent view, Fig. 28, shows the discharge valve, controlled by a weighted lever suspended from the top cover and having a very short fulcrum. The open bucket is suspended from one end of a short lever, the other end being connected by a link to the weight.

In operation, condensation falls into the sediment chamber in the top, overflows into the copper bucket and then overflows into the body of the trap. When the water level surrounding the full bucket is about half way up, the buoyant effect of the water reduces the effective weight of the water in the bucket allowing the weighted lever to fall and operate the discharge valve. When the water level has fallen a certain distance, the bucket drops again, raising the weight and closing the valve.

This trap, along with the T. C. trap, is made by the Kitts Mfg. Co., Oswego, N.Y.

T. C. Steam Trap

This trap is operated by solid weight instead of a hollow bucket, the general scheme of operation being similar to the trap already described. The discharge valve, however, is placed in the top of the body, a pipe extending down below water level to insure a water seal at all times. This arrangement enables the valve and seat to be removed for observation without breaking any pipe connections. The connecting link between the upper and lower levers, Fig. 29, is so proportioned as to form a counterweight for the gravity weight and performs the same function as the weights in Fig. 28.

Strong Steam Trap

Six sizes of this bucket type trap are built by the makers, the Strong, Carlisle & Hammond Co., Cleveland, O., and four sizes of valves and seats are ob-

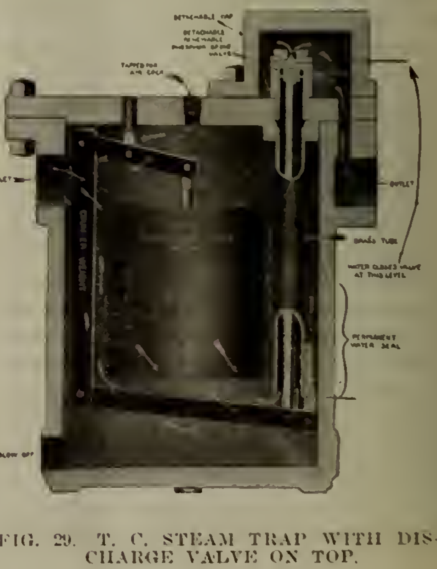
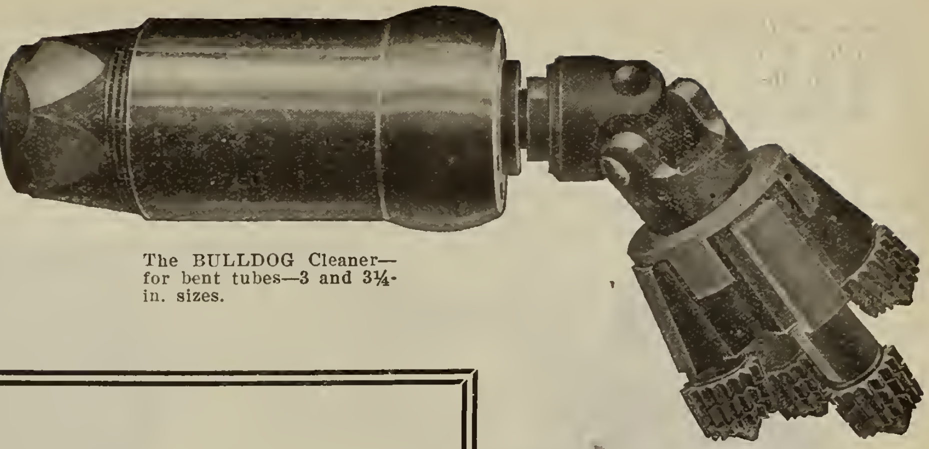
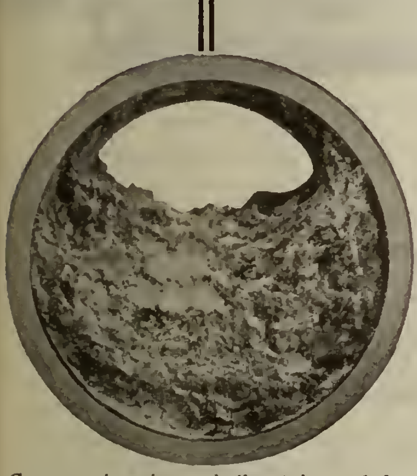


FIG. 29. T. C. STEAM TRAP WITH DISCHARGE VALVE ON TOP.



The BULLDOG Cleaner—for bent tubes—3 and 3¼-in. sizes.

The Bulldog Wins Again



Can you imagine a boiler tube scaled up like this?

This is the kind of a proposition where the "Bulldog" Cleaner" shines.

In this case it was not a test with another make of cleaner, but a battle with scale, and it was some battle. It occurred at a plant in the central part of New York State, and our representative reported that in all his years of tube cleaner experience he had never seen such a proposition.

The 4-in. tubes of a B. & W. Boiler were closed up solid with scale from the first baffles to the back header, but this did not stop the "Bulldog." It waded through those plugged-up tubes and cleaned the scale out clear down to the iron, so that when a tube was finished it shone like a rifle barrel.

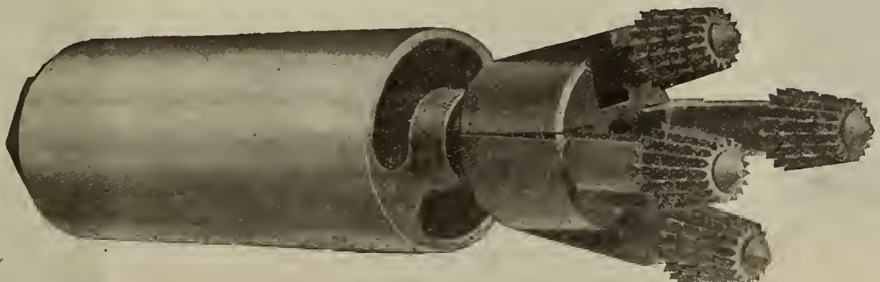
This incident is unusual only in that it is seldom that boilers are permitted to go without cleaning until the tubes are scaled full. The incident is mentioned here to show you what the "Bulldog" Cleaner will do if necessary. Whether your boiler tubes have a thick and heavy scale, or only a thin scale, the "Bulldog" Cleaner will remove it in less time, and with less expense for upkeep or repairs than any other cleaner ever made.

This is a broad claim and would sound preposterous for a new and untried device, but for a tool like the "Bulldog" Cleaner, the ability and quality of which has been demonstrated hundreds of times in the past, the claim seems modest.

The "Bulldog" Cleaner, as well as other types are described in Catalogue "H." Send for a copy now and have it on hand when it is wanted.

Liberty Manufacturing Company
6904 Susquehanna Street
Pittsburgh - Pennsylvania

When a bulldog takes-a-hold of anything it hangs on. Same way with a "Bulldog" Cleaner—it won't let up till the boiler is clean.



The BULLDOG Cleaner—for straight tubes —3½ and 4-in. sizes.

tainable which make the trap suited for —gravity 0 to 10 lbs.; low pressure 10 to 30 lbs.; standard pressure, 30 to 125 lbs.; high pressure, 125 to 200 lbs. Special attention has been given to the design of the bucket in view of the fact that the capacity of a steam trap depends entirely upon the size of the hole in its valve in relation to the pressure under which the trap works. As the permissible area of the hole depends entirely on the pulling force of the bucket mechanism, the importance of this feature is apparent. The particular design of bucket adopted is shown in Fig. 30. As soon as water enters the trap, the bucket, being buoyant, floats and closes the valve, thus putting the trap in operation. As the amount of condensation collected by the trap increases, the water level rises until it overflows into the bucket, causing it to sink, pulling down the valve rod and opening the valve, whereupon the pressure of steam inside the body forces the water up the discharge pipe and through the valve to the outlet. The bucket having now regained its buoyancy, rises on the surrounding water and closes the valve, repeating the operation as described.

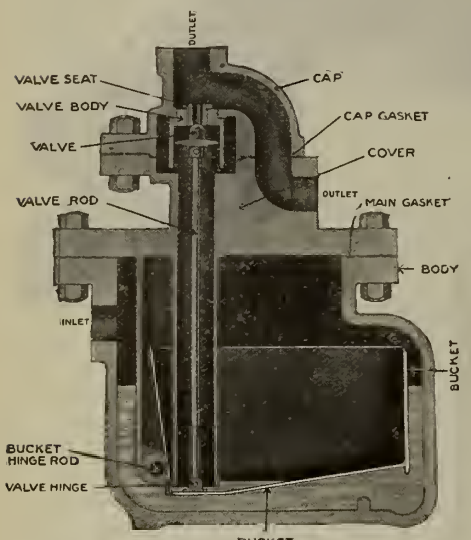


FIG. 30.

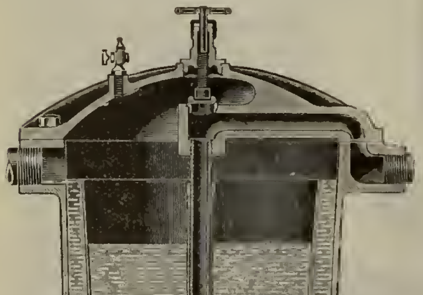


FIG. 31. SECTIONAL VIEW OF STURTEVANT BUCKET TRAP WITH BY-PASS.

The design of the valve is such that the point is loosely attached to the stem, and on account of its shape forms a joint as soon as it touches the seat, regardless of its position. Being of the ball type, the valve simply comes up against its seat to close, and when lifted, gives a full opening, removing any danger of wire drawing.

Sturtevant Steam Trap.

This device is suitable for operation with steam heaters or radiators of any construction. As seen in the sectional view, Fig. 31, the body of the trap contains a pot, which, as the water flows the inlet upon the left into the space around the pot, rises and closes the connection between the interior and exterior. The water accumulates in this space and gradually overflows into the pot until its buoyancy is overcome and it sinks to the bottom. By this action free passage for water is afforded from the pot up through the vertical hollow extension of the cover and thence through the cored passage in the cover to the outer air. The pressure of the steam upon the surface of the water causes this discharge to be rapid, and it continues until the levity of the pot becomes sufficient to cause it to rise and prevent the passage of water by the seating of the extension against the cone screwed into the bottom of the pot.

Both extension and cone are of brass, and are ground to a fit, insuring a tight joint when in contact. The periodic delivery continues as long as there is water to discharge or sufficient steam pressure to cause the trap to act. When starting up, the valve at the top should be opened to allow a free discharge of air, water and steam from the heater. As soon as clear, and steam begins to be blown out, this valve should be closed and the trap allowed to act as already described. As some of the core sand from the heater sections often works into the trap when it is first set up, it is best to open it several times during the first week and give it a thorough cleaning. This is readily done by loosening up the bolts that hold the cover down, when cover and pot can be readily removed. These traps are built by the B. F. Sturtevant Co., Boston, Mass., and are obtainable in suitable construction for different pressures.

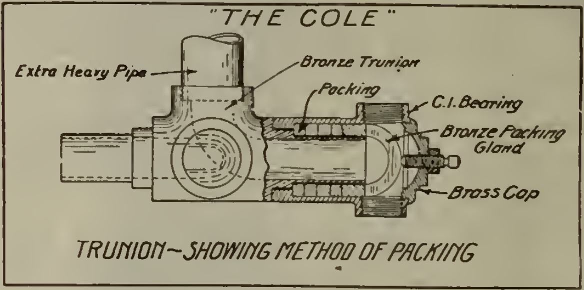


FIG. 33. METHOD OF PACKING TRUNNION IN COLE TRAP.

Cole Boiler Feeder

Where traps are handling water which can be used over again, the economy of returning it to the boiler with as little loss of heat as possible is widely recognized but not always carried out. Steam traps of the tilting tank type are well adapted for this service and in Fig. 32 is illustrated an automatic boiler feeder of this type, manufactured by the Geo. W. Cole Co., Toronto.

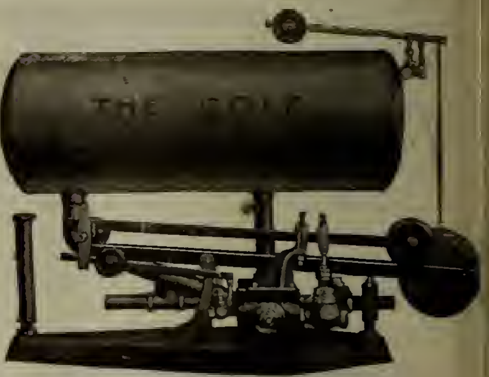


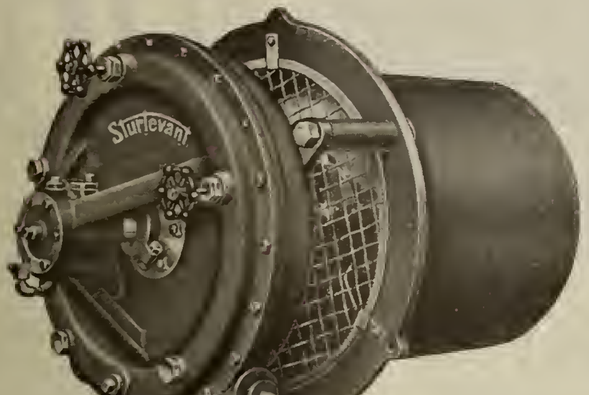
FIG. 32. COLE AUTOMATIC BOILER FEEDER.

A feature of the construction is the method of packing the trunnion bearing on which the tank tilts. As shown in Fig. 33, the bronze trunnion is carried in a cast iron bearing, the packing between them being held in place by a gland, which is tightened by a set screw carried in a brass cap screwed into the cast iron bearing. By removing the cap and gland the bearing may be packed without disturbing any further connections. Seven sizes of this feeder are made, handling from 720 to 18,000 lbs. of water per hour.

◆

DIFFERENT types of electric furnaces, whether for laboratory or for commercial use, may be classified according to the methods employed to transform the electrical energy into heat in the material. These are: (1) By passing the current through the metal to be treated, so that the metal forms a part of the circuit; (2) by passing the current through a resistance material, the heat thus produced being radiated and conducted to the metal: (3) by surrounding the metal with an alternating-current circuit, so that eddy currents are produced in the metal, these currents generating the necessary heat.

The Man Below Cannot Do It All



Sturtevant
(TRADE MARK)

Do not blame the engineer and the fireman if you cannot get all the steam you want—if the pressure goes down—if steam cannot be gotten up in a hurry. It is not all their fault. Your boilers are overloaded, and to get the extra steam you should install a

Sturtevant
(TRADE MARK)

Turbo-Undergrate Blower

It will give you sufficient draft to get over peak load.
Granted that you have decided upon some blower, why not a Sturtevant? Mechanically it is superior to any other.
Take the bearings for instance. There are no ball bearings to rust, crack or give trouble, but instead there are generous bronze journals with oil-ring lubrication. The reservoirs are of ample capacity and will hold an oil supply that will last for several weeks.

Bulletin 214-U tells what the Sturtevant Blower will do. A copy is awaiting you.

B. F. Sturtevant Company of Canada, Limited

GALT, ONTARIO, CANADA

MONTREAL TORONTO WINNIPEG VANCOUVER

Selling Agents: Sanford Riley Stoker Co., Ltd., "THE RILEY STOKER"

BOILER INSPECTION

The Steam Boiler Act, Chapter 252 R.S.O., 1914, With Amendments Chapter 58—6, George V.

STEAM BOILERS.

All Steam boilers constructed for use in Ontario must be built from designs which have been approved and allotted a registration number by the Steam Boiler Branch.

Used boilers, boilers sold or exchanged, and unregistered boilers brought into the Province must be inspected prior to being put into operation.

Notice of repairs to steam boilers, stating the nature and extent of same, must be sent to the Steam Boiler Branch, and should such repairs be considered extensive by the Chief Boiler Inspector, the boilers will require to be inspected.

In each and every case the inspections must be made by Inspectors authorized to inspect boilers under the Steam Boilers Act, who are employed only by the Steam Boiler Branch of the Department of Public Works. Official certificates with the maximum working pressure stated thereon are issued to the owners of the boilers so inspected.

STEAM PIPING.

Drawings and Specifications of all high pressure steam piping must be approved and registered by the Steam Boiler Branch before any work of installation is commenced. The drawings submitted should show clearly the dimensions and layout of the main steam lines. Full particulars should be given as to the material used in the construction of the piping, and all valves and other fittings used in connection therewith must be of approved make.

Any deviation from the above requirements shall be deemed a violation of the Steam Boilers Act.

All communications in this respect should be addressed to the Steam Boiler Branch, Department of Public Works, Parliament Buildings, Toronto.

HON. F. G MACDIARMID,
Minister of Public Works
and Highways.

W. A. RIDDELL, M.A. Ph.D.,
Supt. Trades & Labour Branch

D. M. MEDCALF,
Chief Inspector of Steam Boilers.

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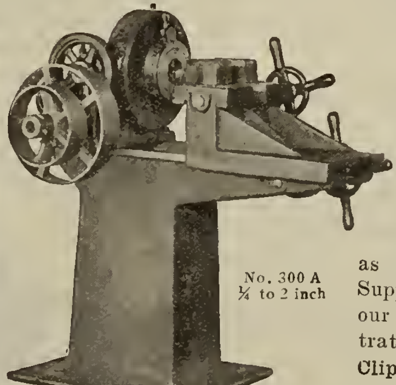

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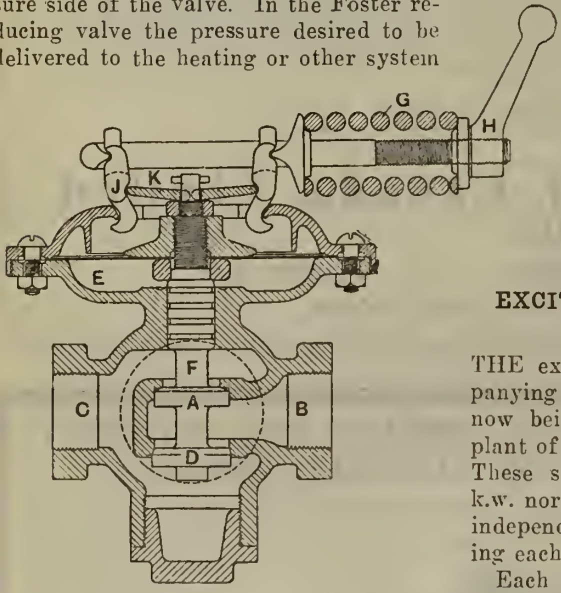
Progress in New Equipment

PRESSURE-REDUCING VALVE

THE sectional view shows a Foster patent reducing valve embodying improvements which have for their object quieter and smoother action and more gradual and uniform passage of the fluid from the high to the low-pressure side of the valve. In the Foster reducing valve the pressure desired to be delivered to the heating or other system is set and automatically governed by an adjustable spring acting through a system of toggle levers on a diaphragm in the valve chamber. This diaphragm has a spindle passed through it; one end of the latter is engaged by the toggle levers, while the other end carries a double-beat valve having two seatings in the valve body through which steam or any fluid under pressure is passed. The invention consists essentially in forming one of the double-beat valves as a sliding piston valve, whilst the other valve of the pair is of the usual bevel-edged type.



PRESSURE REDUCING VALVE.

Referring to the illustration, B designates the inlet and C the outlet of the valve, E the diaphragm, F the valve stem, A D the double-beat valves, G the adjustable spring, H a nut on the screwed portion of the spring rod for regulating the delivery pressure, and J toggle levers acting in combination with links K. The valve A of the double-beat valves is made in the form of a sliding piston valve as shown, while the other valve D of the pair is of the usual bevel-edged lift type, by which means high-pressure steam is enabled to pass first through the lift valve D whilst the piston valve A remains closed until the delivery pressure is reduced to such a point that the piston valve A is also opened and the steam or fluid passes through hoth the double-beat valves in a greater volume. It is claimed that "wire drawing" or cutting action on the valve face and seats is thereby prevented. Sir W. H. Bailey & Co., Salford, England, are makers of the foregoing apparatus.

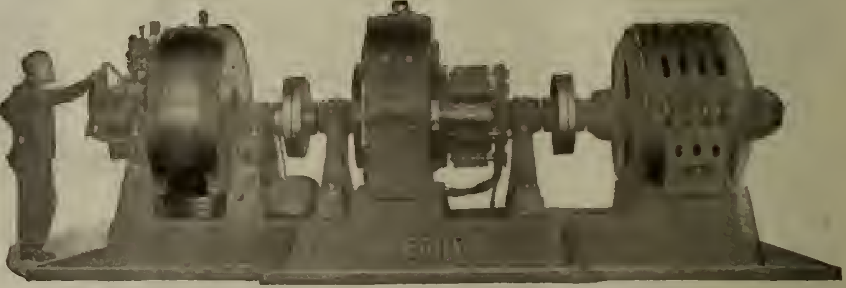
—❖—

EXCITER UNIT WITH DUPLEX DRIVE

THE exciter unit shown in the accompanying illustration is one of a number now being installed in the new power plant of the Buffalo General Electric Co. These sets are of large capacity—300 k.w. normal—and are provided with two independent sources of power for driving each exciter.

Each unit consists of a 300 k.w. exciter direct-connected to an induction motor at one end and to a steam turbine at the other end. The governing mechanism of the turbine is so arranged that if the power for the induction motor should fail, the turbine would automatically pick up the load. In case of trouble on the main circuits, the exciters can be depended upon to take care of themselves without attention, and the operators can give all their attention to clearing up the trouble on the main circuits, while with ordinary motor-driven exciters the exciter unit shuts down as soon as the voltage of the main circuit fails, and it is necessary to start up an independent unit before voltage can be restored to the main circuits.

Another advantage of the Duplex Exciter Drive is that it gives the exciter unit a higher all-day efficiency than either a motor-driven or a steam-driven exciter. This maximum efficiency is secured by driving the unit from the turbine end when the station is operating at full load and the turbine exhaust can be used efficiently in the heaters, and by shifting the drive to the motor end when the station load is light, and the main generators can easily carry the exciter load. The turbines were manufactured and the units assembled by the Terry Steam Turbine Co., Hartford, Conn.

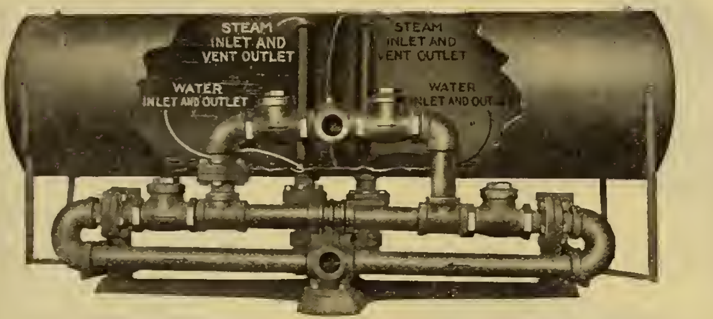


EXCITER UNIT WITH DUPLEX DRIVE.

—❖—

BALL THRUST BEARINGS

THE Rochester Ball Bearing Co., Inc., of Rochester, N.Y., has introduced a line of ball thrust bearings which, while they do not incorporate any radical departure from generally accepted good practice in this line of manufacture, embody a number of interesting features. Of special merit in these bearings is the solid brass retainer. Experience has shown that a large proportion of ball thrust bearing failures are traceable to the use of sheet metal retainers, which wear rapidly, allowing particles of steel to fall into the races. The shock and extra wear, due to the balls running over these particles, eventually ruins the bearing. This, it is claimed, cannot happen with solid brass retainers. These bearings are usually made with round grooves, although V groove bearings are regularly



Farnsworth Duplex Boiler Feed Tilting Trap

Farnsworth Tilting Traps were designed and built after proving by the test of time that others on the market were not wholly satisfactory. In our traps we have eliminated the troubles incidental to packed trunnions which bind and leak; the oscillation of the tank on knife-edge trunnions operates a substantial straightway "Everlasting" Blow-off Valve.

To start the trap, hold down the short end and allow condensation to completely fill the tank—once suffices for all time. Then release, and the long end tilts down, opening the outlet valve, allowing the trap to discharge until the long end is drained through a diagonal pipe into the short end, thence out through the discharge valve. The tank then oscillates, the short end tilting down, closing the outlet valve and allowing condensation to again accumulate in the long end. This procedure continues until the line is completely drained. Steam is water-sealed and cannot escape.

Various styles of traps are produced by an ingenious arrangement of additional valves, always employing the positive valve control.

Our Feeder for this service has superior advantages over any other known method for collecting condensation (also make up water) and returning it directly into the boiler. ¶This apparatus combines into one the hot well, air pump, vacuum devices, heater and boiler feed pumps; efficiency and economy (first cost and maintenance) are the result, effected by the saving of heat lost by reduction in pressure and radiation by passage through unnecessary apparatus. ¶It creates and maintains the vacuum. ¶By our closed system the condensation is returned under its original pressure and at a higher temperature than a pump can handle it. ¶For every 10 degrees of heat saved there is a saving of 1 per cent. of coal: our apparatus will quickly pay for the installation. ¶Unlike a pump, one cubic foot of H. P. steam admitted into our apparatus displaces one cubic foot of water; no steam is wasted; that used for pumping preheats the water; hence further economy over a steam-pump and receiver.

Write for Special Catalogue.

No Packed Trunnions to bind or leak. Operate substantial "Everlasting" Blow-off Valves. Tank oscillates on Knife-Edge Trunnions. Positive Valve Control—no weights or levers. Condensation only Controls Operation. Steam is Water Sealed. No loss. Requires no packing, lubrication or attention. Simple—Durable—Efficient.

***Other Farnsworth Products*—Non-return Separating Trap, Lifting or Pumping Trap, Direct Return Trap**

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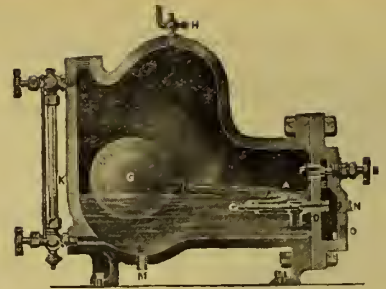

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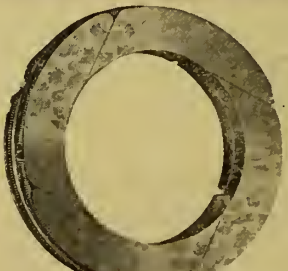


Packing You Will Appreciate

Cut at a tangent to the piston rod and joints on diametrically opposed sides of the piston are parallel. This arrangement of the joints of the ring allows the parts to adjust themselves to every slight inequality of wear in the diameter of the rod as they float freely. Friction and wear upon the rod are practically negligible.

No clearance for wear adjustments need be left between the ends, and sudden failure with this type of packing is impossible.

The Martell Packing Company, Inc., Elyria, Ohio

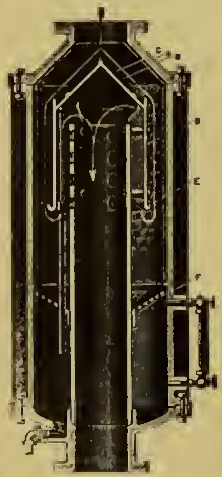
Canadian Agents: THE CANADIAN FAIRBANKS-MORSE COMPANY, LIMITED

CFM

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

III IMPORTANT THINGS

TO CONSIDER ABOUT A SEPARATOR.



I. THE PLAN—Is it sensible, will it work, no matter how large the Separator or how well made?

II. THE SIZE—Is it big enough regardless of plan, will it hold a good dose of water?

III. THE CONSTRUCTION—Is it strong enough, are flanges heavy, how will it look by the side of a nicely finished engine? Send for catalog and note these points in

Sweet's Separators

DIRECT SEPARATOR COMPANY

820 Geddes Street - SYRACUSE, N.Y.

General Sales Agents:

Canadian Fairbanks-Morse Co., Limited
St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Vancouver, Victoria.

CFM

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

FOR Steam or Air Drill, Pneumatic Tools, Boiler Flue Cleaning, Syphon Connections, Suction Lines.

For all kinds of Oil, Gasoline, Paints, Hydraulics, Gas.

"PENFLEX" METAL HOSE

INTERLOCKING

An all Metal Flexible Hose. Manufactured in Bronze or Galvanized Steel. Will withstand highest pressures. Is unsurpassed for durability and pressure resisting qualities.

Large Stock Carried in Canada

Pennsylvania Flexible Metallic Tubing Co.
Philadelphia, Pa.

Canadian Agents:

The Canadian Fairbanks-Morse Co., Limited
St. John, Quebec, Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria

CFM

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

If any advertisement interests you, tear it out now and place with letters to be answered.

If You Expect Long Service

from Rod Packing don't use the kind that produces friction.

TRADE-MARK

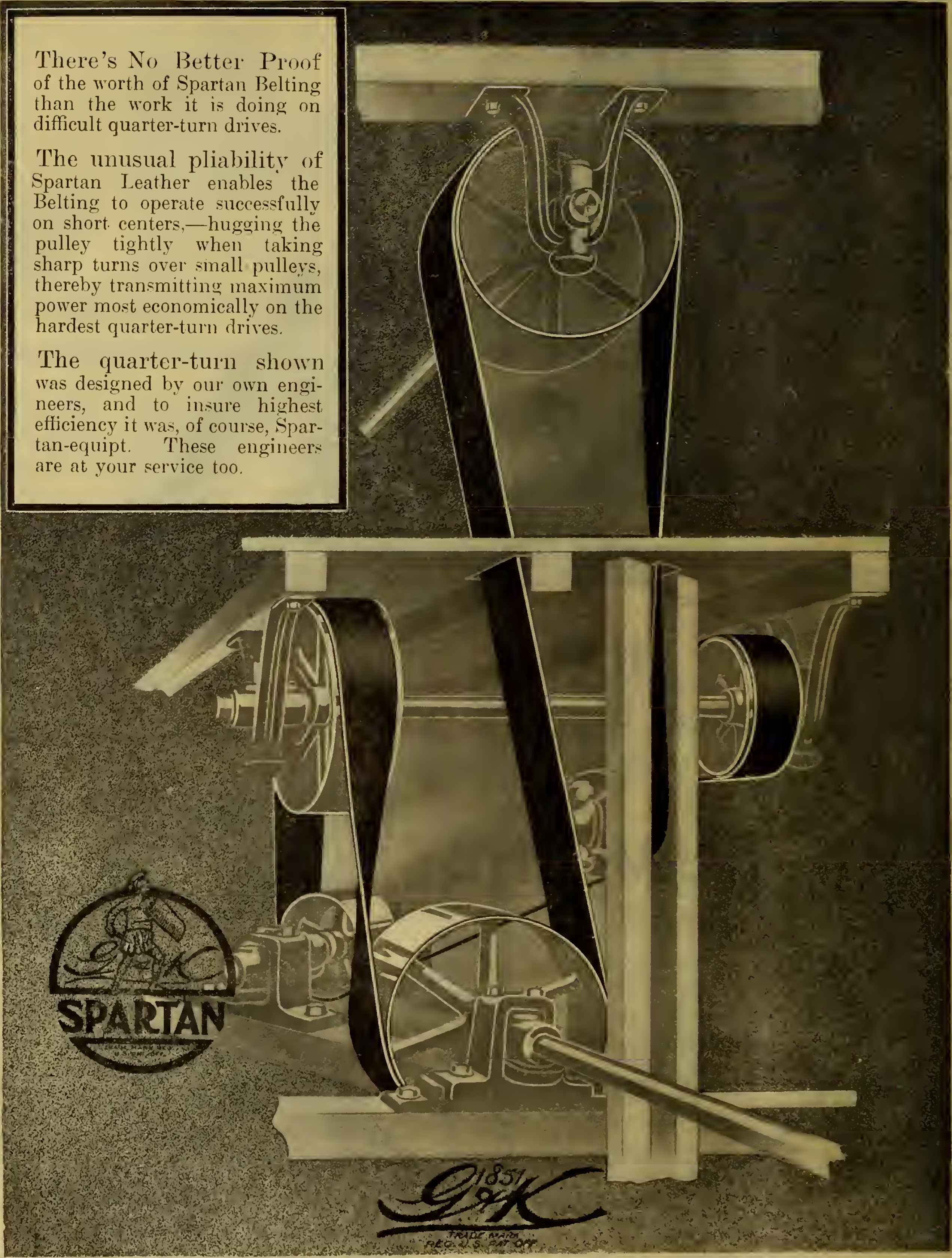
"PALMETTO" PACKING

carries lubricant in each single strand which keeps the rod in such a perfect state of lubrication that the friction that destroys the packing and wears the rod is avoided.

Why not test "Palmetto's" frictionless qualities—we will send you a free working sample.

Greene, Tweed & Co.
Sole Manufacturers
109 Duane St., New York

Representatives in Canada:
THE CANADIAN FAIRBANKS-MORSE COMPANY, Limited.
St. John, Toronto, Quebec, Hamilton, Montreal, Ottawa, Vancouver, Victoria.



There's No Better Proof of the worth of Spartan Belting than the work it is doing on difficult quarter-turn drives.

The unusual pliability of Spartan Leather enables the Belting to operate successfully on short centers,—hugging the pulley tightly when taking sharp turns over small pulleys, thereby transmitting maximum power most economically on the hardest quarter-turn drives.

The quarter-turn shown was designed by our own engineers, and to insure highest efficiency it was, of course, Spartan-equipt. These engineers are at your service too.

The Graton & Knight Mfg. Co., Worcester, Mass.

The Canadian Fairbanks-Morse Co., Limited

St. John, Montreal, Quebec, Ottawa, Toronto, Hamilton, Windsor, Winnipeg, Saskatoon, Calgary, Vancouver, Victoria.

CANADA'S DEPARTMENTAL HOUSE FOR MECHANICAL GOODS

Pratt & Cady Valves

In New Montreal Filtration Plant

Number one—20″ valve.
Number two—10″ operating cylinders.
Number three—24″ valve.
Number four—30″ valve.

Pratt & Cady Valves were chosen because they have the reputation for absolute reliability under the most trying conditions.

All three of these valves are Hydraulically operated. They form a portion of an order for 128 valves built especially for the Montreal Filtration plant.

The gate mechanism shown in the small insert, is of the Double Disc Parallel Seat type recognized as most suitable for water control.

These valves are easily operated, will take the pressure from either side and will not wedge.

The stem and stem nut are of solid bronze, preventing rust or corrosion.

A trial of these valves will give convincing proof of their superiority, especially in heavy service.

Pratt & Cady Valves are made in all styles and sizes for all purposes.

We will gladly send you full information on request, and quote prices on receipt of your specifications.

Manufactured by
PRATT & CADY COMPANY
HARTFORD, CONN.

General Sales Agents:
The Canadian Fairbanks-Morse Company, Limited

St. John Montreal Ottawa Toronto Hamilton Quebec
Calgary Edmonton Vancouver Winnipeg Victoria

Consult Power House Buyers' Directory

If what you want isn't advertised in this issue, consult our Buyers' Directory. If it isn't listed in our Directory, write us and we will give you the information.

Season's Greetings

To Our Readers:

IN extending to our readers our best wishes at this time it is with no idle desire to follow conventional rules. It is with true sincerity that we extend the compliments of the season, and to wish you all a prosperous New Year.

The year now drawing to a close has seen Power House expand at a very gratifying rate, and we say gratifying advisedly, because we have labored hard and earnestly to give you a paper worth while. Our plans for the new year include many interesting features, and we predict that you will secure even more benefit from your paper during the next twelve months than you have during the twelve just past.

We do not believe you will find a more up-to-date, more carefully edited paper anywhere than The Power House, and yet we are not satisfied. Criticism and suggestions are always welcome — even more welcome than praise. If you can suggest any feature which you think will benefit you or our readers in general, we shall feel greatly indebted to you, if you will write us fully outlining your ideas.

There is a way in which you can help us very materially and we earnestly solicit your assistance in this respect—i.e., recommend The Power House to your friends and acquaintances. It is a real paper for Canadians, and it is not enough that **you alone** should read and enjoy it. Pass the Good Word along, if you know of any engineer who is not getting The Power House, that our circulation may be even more thorough than it is at present. Do not be a silent friend, but be rather an ardent, audible booster! We'll reciprocate—never fear! Co-operation as a word is overworked, but co-operation itself can never be overworked. Let co-operation be the keynote of our relations during 1917.

Again wishing you the compliments of the season, and thanking you one and all for the liberal co-operation of the past, we are

Yours sincerely,

THE POWER HOUSE.

made for high speed, light duty conditions, special bearings being, in addition, made to order. Thrust bearings for heavy duty are made with self-aligning spherical seat washers. The illustration shows medium weight bearings of large size. The retainers of small bearings are not scalloped.

NEW BALL TYPE THRUST BEARING.

◆

Trade Gossip

Brantford, Ont.—The Town Council contemplate installing a water filtration plant.

Toronto, Ont.—Gunns, Ltd., are building an extension to their abattoir to cost $3,500.

Lindsay, Ont.—Flavelles, Ltd., have decided to rebuild their cold storage plant, recently destroyed by fire.

Dartmouth, N.S.—The Town Council propose making extensions to the water and sewerage systems, at an estimated cost of $6,800.

The Canadian Ice Machine Co., Toronto, have been awarded a contract for a cold storage and ice plant for the General Hospital, Sault Ste. Marie, Ont.

Toronto, Ont.—The William Davies Co. have been granted a permit for a cold storage building at Front and Cypress Streets, to cost $100,000.

Hepworth, Ont.—It is proposed to submit a by-law to the ratepayers in the near future to authorize the installation of an electric light and power plant.

Hamilton, Ont. — By-laws will be voted on at the January elections to raise $5,869,286 for a hydro-electric radial from Port Credit to St. Catharines and $362,500 for new pumps.

Welland, Ont.—The local Hydro Commission will shortly begin the construction of a new sub-station at an approximate cost of $40,000. The station will not be in operation before next September.

The Universal Smokeless Heat Generator Co., Victoria, B.C., has been incorporated for $50,000. It will acquire patents held by its stockholders for improvements in heat-generating processes and furnaces.

R. J. Durley, Ma.E., of Montreal, has taken over the unfinished work previously handled by the Montreal office of the firm of MacMullen, Riley & Durley, which was recently dissolved and reorganized as MacMullen, Riley & Angus. Mr. Durley will also continue his consulting practice.

The Sterling Engine Works, Ltd., of Winnipeg, has been incorporated with a capital stock of $25,000 by Vincent C. Maddock, Roy M. Wolvin, William J. Leaney, and others, to manufacture steam and gasoline engines, boilers, agricultural implements, etc.

Port Arthur, Ont.—The citizens will vote at the January elections on a by-law to authorize a contract with the Hydro-Electric Commission to develop, construct and acquire Dog Lake Power. It is estimated that about 30,000 h.p. will be developed.

Fraser & Chalmers of Canada, Ltd., Montreal, have been appointed Canadian agents for the Nordberg Mfg. Co., of Milwaukee, Wis., manufacturers of air compressors, hoists—steam, air and electric—Diesel engines, etc. The Nordberg Company make large Diesel engines of the Carels type. Geo. Sancton is general manager of the Fraser & Chalmers Co.

Chatham, Ont.—Ratepayers will be asked at the January elections to endorse debentures to the extent of $45,000 to provide for extensions that have been made and are being planned to the Chatham Hydro system. A large increase in customers from 600 to 1,350, has been responsible for the projected developments.

The Canadian Fairbanks-Morse Co., Montreal, have been awarded a contract by the City of Charlottetown, P.E.I., for the supply of a pumping outfit, consisting of a Gould's horizontal single-stage double-suction brass-fitted centrifugal pump. The pump will be belt-driven from a Fairbanks-Morse 15 h.p. type "Y" semi-Diesel oil engine. The unit will have a capacity of 850 U. S. gallons per minute against a total head of 30 feet when operating at 975 r.p.m. The engineers are R. S. & W. S. Lea, Montreal.

Montreal, Que.—A committee of nine prominent Montreal engineers, after a thorough investigation of the aqueduct

Do You Know Why The Steam Trap

SARCO

is used by nearly all the big industrial concerns?

This Is Why

The Steam Trap SARCO is operated by the expansion of a liquid operating a spirally corrugated tube. There is no other steam trap made which uses liquid expansion, and none can use this enormously powerful and reliable operating medium without using also the Sarco tube. Therefore, of all thermostatic traps the SARCO claims to be the most positive—and it can be supplied not only for vacuum heating systems, but for low pressure and high pressure steam up to 200 lbs. Do you know any other thermostatic trap used successfully for pressures above 50 lbs. or even as high?

Then as to installation. The SARCO fits in anywhere (1" size measures only 7½ inches), it needs no floor space or building up, but can be used as an elbow or bend, in the discharge. Although it does just the same work, it is not a heavy, cumbersome affair like a float or bucket trap. It is not a tank, but a piece of live pipe.

Price—it is the cheapest trap on the market, and owing to the enormous increase in sales and improved manufacturing facilities, we have not had to increase prices in three years. Take a trap on thirty days' trial and prove what you gain in first cost, cost of installation, and in steam saved.

Write for bulletin J 1.

Sarco Company, Inc.

Woolworth Bldg. NEW YORK — Old Colony Bldg. CHICAGO

Sarco Agents In Canada:

Peacock Bros. - Montreal
A. R. Roberts - Toronto

Classified Advertisements

USED POWER EQUIPMENT.

ENGINES.

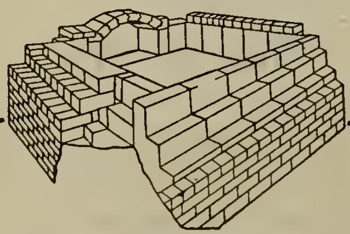
75 H.P., 16 x 36 Leonard Corliss, used less than year; heavy duty type.
85 H.P., 13 x 30 Brown automatic, excellent condition.
75 H.P., 12 x 30 Inglis Corliss
75 H.P., 12 x 12 Robb high-speed.
20 H.P. Robb high-speed.

BOILERS.

72 x 18 horizontal return tubular, shaking grates, Government inspected.

GENERATORS AND MOTORS.

200—300-light dynamos.
20, 25, 35, 250-volt motors.
50 H.P. gas engine and producer, good as new, at great bargain.
Hobbs & McGill, Mail Building, Toronto, Ont.



Gates Boiler Furnace

Patent Applied For

Will last three times as long as ordinary good grade Fire Brick. These blocks are inter-locking, and made so that any handy man or fireman can renew them without disturbing any of the other brick work.

—*WRITE FOR PARTICULARS*—

John W. Gates, 382 St. James St., Montreal, Que.

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M. Can. Soc. C.E. M. Can. Soc. C.E.
M. Am. Soc. C.E. Mem. Am. Soc. M.E.
M. Inst. C.E. Mem. A.I.E.E.

WALTER J. FRANCIS & COMPANY
CONSULTING ENGINEERS
Head Office, 232 St. James St., Montreal
Cable Address, "Walfran, Montreal"—W.U. Code.
Long Distance Telephone, Main 5643.

Works Equally Well on Hot and Cold Surfaces. It Cannot Blow Up. Cleans, Polishes and Preserves all kinds of metals.

Tear this off as a reminder

Geo. Wm. Hoffman Co.,
557 E. Wash. St.
Indianapolis, Ind.

Enclosed find 10c in stamps, for which send me one large 50c can of U. S. Metal Polish Paste.

Name ....
Address ....
....

scheme, have advised that the project should never have been started, and that all thought of completing it should be abandoned. A sum of $5,200,000 has already been expended, and it would require $5,000,000 more to complete it. The main contentions are that the capacity of the original aqueduct was sufficient for three times the present population served, and that the cost of developing power as proposed would be too excessive.

Francis Hankin & Co., Montreal, have been awarded a contract for water meters by the city of Montreal, valued at $25,702. The meters range in sizes from 2 in. to 8 in., and will be placed in lines supplying the harbor front fire protection system. The fire hydrants in the system are all connected beyond the meters and it was therefore essential that a minimum loss of pressure should be caused through the meters. This British-made meter known as the "Helix," showed a loss of about 4¾ lbs. only and this feature decided the contract in its favor.

◆

Catalogues

Belts, the house organ of the Federal Engineering Co., Toronto, November issue, contains considerable useful information regarding belts, their use and maintenance.

The Nash Engineering Co., South Norwalk, Conn., have issued three bulletins, No. 4, 5 and 6, dealing with different types of equipment which they manufacture. Bulletin No. 4 illustrates and describes fully, turbine, vacuum, and low pressure boiler feed pumps for return line heating systems. No. 5 is devoted to a description of the Nash hydro-turbine, air compressors and vacuum pumps, single stage type. No. 6 deals fully with hydro-turbine vacuum pumps integral with electric motor. In each case details of construction are given and tables included giving the principal dimensions and other particulars of the various units.

Arc Lamp Carbons. — The Electrical Engineering & Equipment Co., London, England, have issued a new catalogue, A. B. 1, dealing with an extensive line of arc lamp carbons, carbon brushes, battery carbons and other similar products. Among the arc lamp carbons listed is a special line for cinematograph work, of various qualities. As the carbon brushes are made in various grades, a summary of brush characteristics is given for each grade with remarks stating the class of work for which each is best suited. In this connection there are also a series of characteristic curves and particulars covering the various grades. Other carbon products listed, include brushes for special work, plates, rods, blocks, contacts, carbon tubes, etc. The catalogue is fully illustrated, and contains nine complete price lists.

Structural Steel Work

Penstocks
Transmission Line Towers
Bridges
Steel for Dams
Oil Tanks
Air Receivers
Water Tanks

We carry a large stock of Steel Plates, Channels, Beams and Angles.

PROMPT DELIVERIES.

MacKinnon, Holmes & Co., Limited
Sherbrooke, Que., Canada

Give your belts a square deal by using

DIXON'S
Solid Belt Dressing

Don't let them go hungry and starve. They can't give you service unless they are properly treated.

The use of Dixon's Belt Dressing means added power to your plant, longer life to your belts.

Send for Booklet No. 222-O.

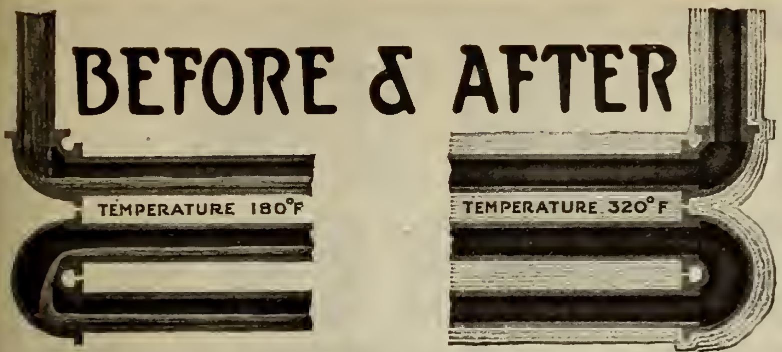
Made in JERSEY CITY, N. J., by the
Joseph Dixon Crucible Company
Established 1827

Canadian Representatives:
THE CANADIAN ASBESTOS CO.
Montreal, Que.
O—22

MONCRIEFF'S "UNIFIC" WATER GAUGE GLASSES

Stand in a Class by Themselves for Quality, Efficiency and Economy
A trial will convince you. Write for Catalog

W. J. WALL, 134-136 BLEURY ST., MONTREAL
(Canadian Representative)



Sluggish Steam Lines cause trouble and expense. Many an engineer using steam for heating, drying or cooking is unmindful of the fact that his complaint of "I can't get those pipes hot enough," arises from condensation clogging the lines. A magical change can be wrought by installing the

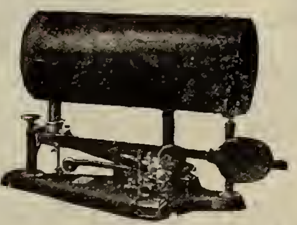
Morehead
Back to Boiler
SYSTEM

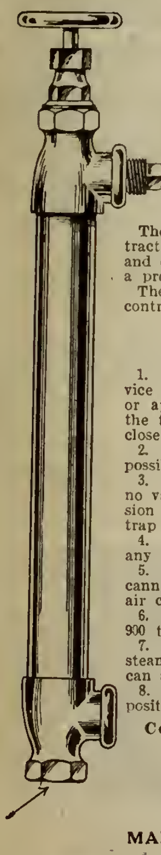
Every line, machine, kettle, etc., will become piping hot—maximum heating point. The condensation is shot back to the boiler under pressure, with practically no loss of heat, as pure hot feed water.

As a boiler feed the Morehead System has no equal. Get reasons why

Canadian Morehead Manufacturing Co.
Woodstock Ontario

Which is Yours ?





The Long
Patent Steam Trap
Has but One Moveable Part

The valve actuated by the expanding and contracting of a tube, a motion that is positive and of sufficient force to close the valve against a pressure of two hundred pounds.

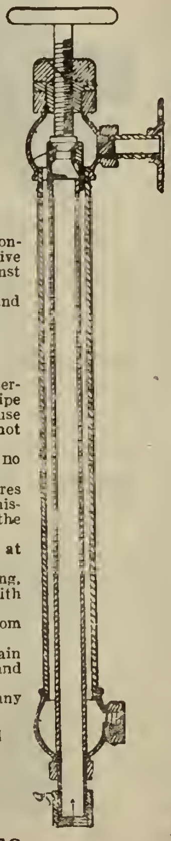
The movement is due to the expansion and contraction of metals.

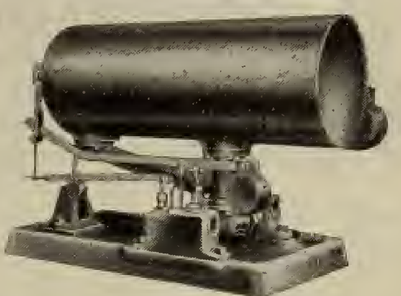
Its Advantages

1. Before the Long trap goes into actual service all air and water is expelled from the pipe or apparatus to which it is connected because the trap is wide open when cold, and does not close until steam appears.
2. When the Long trap is used there is no possibility of freezing if set so as to drain.
3. The Long trap is automatic and requires no valves except those which control the admission of steam to the apparatus to which the trap is attached.
4. The Long trap is regulated to work at any pressure between 1 and 200 pounds.
5. The Long trap being open at starting, cannot become air bound, thus doing away with air cocks or vents.
6. The Long trap is capable of draining from 900 to 1,500 feet of one-inch pipe.
7. The Long trap may be applied to drain steam mains, jacket kettles and separators, and can also be used in drying room systems.
8. The Long trap can be installed in any position desired.

Correspondence from Heating and Power Engineers invited.

J. T. LONG
84 Adam Street
MAISONNEUVE, MONTREAL, QUEBEC
Patentee and Manufacturer





Paid For Itself in Thirty Days

The chances are that if a device does not prove its worth in thirty days there is little chance that it ever will. But think of this

"Detroit" Systems for Handling Condensation

have records of paying for themselves in thirty days.

Not only will a "Detroit" System pay for itself in a short time, but will continue to save hundreds of dollars a year right in your boiler room by saving fuel.

In your boiler room, as in many others, there is [illegible] adequate provision made to return the condensation.

Better let us send you "Watch Your Condensation."

CANADIAN *Sirocco* COMPANY
LIMITED
WINDSOR, ONTARIO.

SALES OFFICES:

Canadian Sirocco Co., 526 Traders Bank Bldg., Toronto. Phone Main 5118.
A. M. Nichol, McGill Bldg., Montreal.
S. S. Clarke, 605 W. Second St., Calgary.
W. W. Hicks, 567 Banning St., Winnipeg.
Canadian Sirocco Co., Ltd., 604 Credit Foncier Bldg., Vancouver.

HINTS TO BUYERS

DOMINION COAL COMPANY LIMITED

"Dominion" and "Springhill" BITUMINOUS STEAM and GAS COALS

GENERAL SALES OFFICE

112 St. James St. Montreal

NOTICE TO Stationary and Hoisting Engineers

Everyone operating a STATIONARY steam plant of 50 h.p. or over in the Province of Ontario must hold a Stationary Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Everyone operating a HOISTING steam plant working at a pressure of 20 pounds or over, irrespective of horse power, and used for hoisting in structural operations or excavating purposes, in the Province of Ontario, must hold a Hoisting Engineer's Certificate from the Board of Stationary and Hoisting Engineers. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary and Hoisting Engineers' Act.

Application forms for obtaining STATIONARY or HOISTING Engineers' Certificates, may be had upon applying to the Chairman.

HON. F. G. MACDIARMID, W. C. McGHIE,
Minister of Public Works and Highways. Chairman of Board.

McDANIEL IMPROVED STEAM TRAP

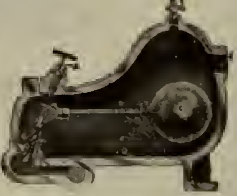
FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators.

SEND FOR CATALOGUE.

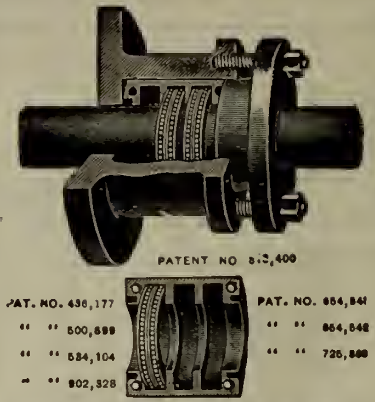


THE GARTH COMPANY

26 Craig Street MONTREAL, CAN.

WATSON & McDANIEL CO.

No. 146 N. 7th Street, PHILADELPHIA, Pa.



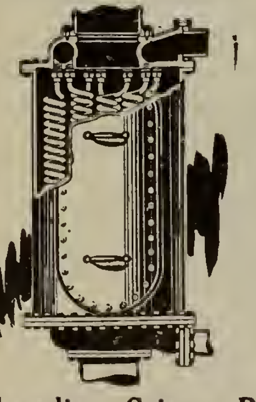
Why not Buy the Best, when in market for Packing?

HOLMES' Metallic Packing

is Guaranteed 3 years

Lasts many times longer. 30 days' trial. Less oil. No cutting. Easily applied to any Steam Engine, Air Compressor or Gas Engine. Satisfaction or no pay. Write us.

Holmes Metallic Packing Co., Wilkes-Barre, Pa.



Reilly Multicoil Feed Water Heater

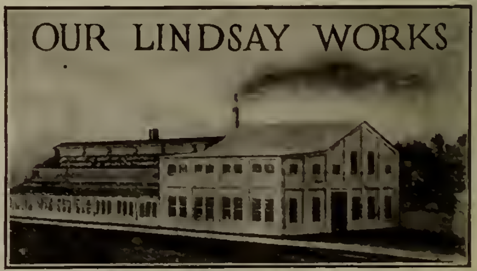
Has greater capacity per square foot of heating surface than any other type of closed heater. It is simple in construction, light in weight and small in size.

Write for Bulletin No. 210.

Canadian Griscom-Russell Co., Ltd.

960 St. Paul Street, Montreal, Quebec

Water Turbines, Hydraulic Governors, Centrifugal Pumps



Boving Hydraulic & Engineering Co., Limited

LINDSAY, ONTARIO

THE LADD VERTICAL WATER TUBE BOILER

The Goldie-McCulloch Co., Ltd.
Galt, Ontario

Canadian licencees under patents 162401 and 162402 dated May 4, 1915.

The George T. Ladd Company,
Pittsburgh, Pa.
Owners and manufacturers for the United States.

Write for new Catalogue No. 17.

BELTS

We issue each month a book giving information useful to belting users. This book is intended to give serviceable information to the public and is not merely an advertisement of our product. We are trying to get and keep our customers by giving them as much help as possible.

FEDERAL ENGINEERING CO'Y., LTD.
92 Sherbourne Street, TORONTO

BOILER ACCESSORIES

By Walter S. Leland, S.B.

Formerly Assistant Professor of Naval Architecture, Mass. Institute of Technology, American Society Naval Architects and Marine Engineers. 144 pp., 72 illus. Cloth binding. A treatise giving complete descriptions of the various accessories of the boiler room and engine room essential to economical operation, such as evaporators, pumps, feed-water heaters, injectors, mechanical stokers, etc., with practical instruction in their use. Price $1.00

STEAM TURBINES

By Walter S. Leland, S.B.

Assistant Professor of Naval Architecture, Massachusetts Institute of Technology, American Society of Naval Architects and Marine Engineers. 160 pp. 100 illus. Cloth binding. A reliable and up-to-date manual on the selection, construction, and operation of steam turbines, including the installation, performance and types of turbines; single-stage and compound turbines, such as De Laval, Riedler-Stumpf, Rateau, Hamilton-Holswarth, Terry, Parsons, Allis-Chalmers, etc., with a discussion of the use of low-pressure steam turbines with steam engines. Price.......... ....$1.00

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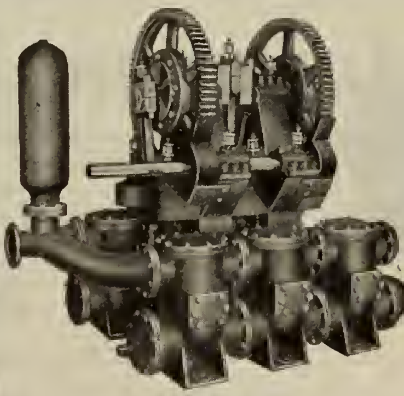
THE MACLEAN PUBLISHING COMPANY
143-153 University Avenue TORONTO

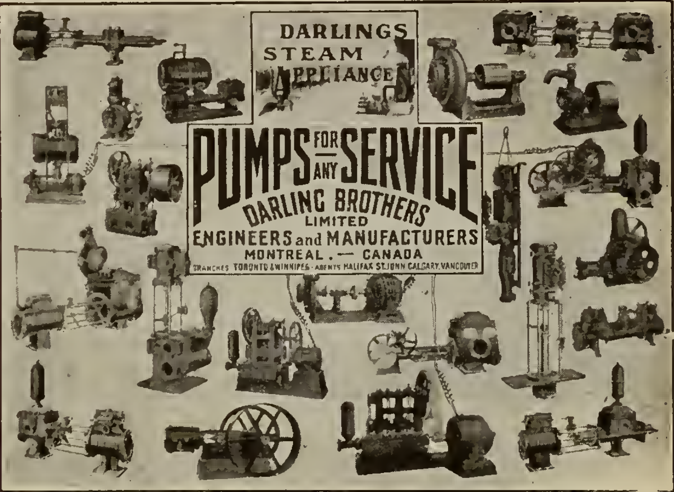


PUMPS

for every service. Specially designed to meet your needs

The Smart-Turner Machine Co., Ltd.

Hamilton - Canada


DARLINGS
STEAM
APPLIANCES
PUMPS FOR ANY SERVICE
DARLING BROTHERS
LIMITED
ENGINEERS and MANUFACTURERS
MONTREAL. — CANADA
BRANCHES TORONTO & WINNIPEG - AGENTS HALIFAX ST. JOHN CALGARY. VANCOUVER

Self-Lubricating

In Cans
6, 12, 25 and 50 lbs

SAFETY PLASTIC
METALLIC PACKING
FOR STEAM, WATER, AIR, GAS, ETC.

LASTS FOR YEARS AND NEVER WEARS THE PISTON ROD.

Guaranteed to stand steam temperature up to 550 degrees Fahr.
Guaranteed to stand hydraulic pressure to 5,000 pounds per square inch.
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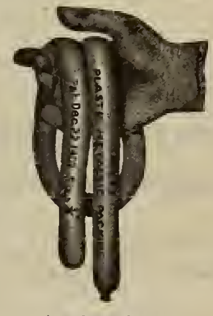

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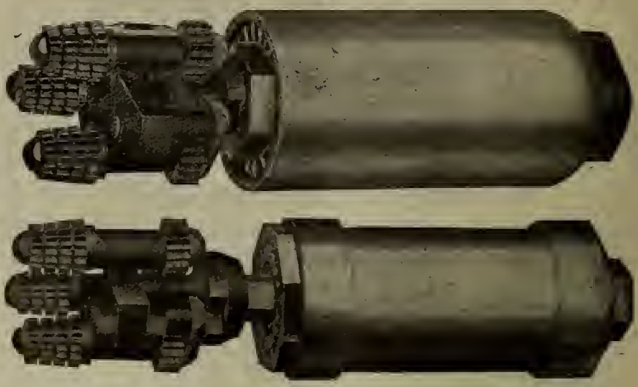

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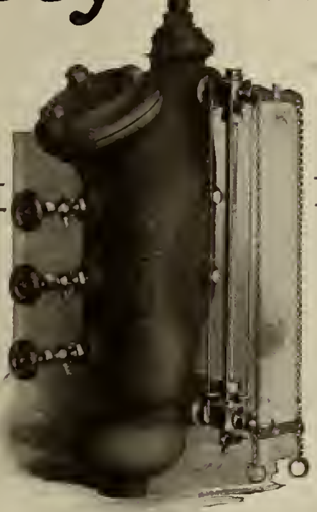

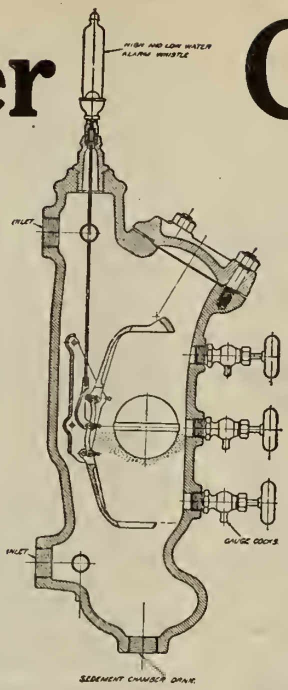

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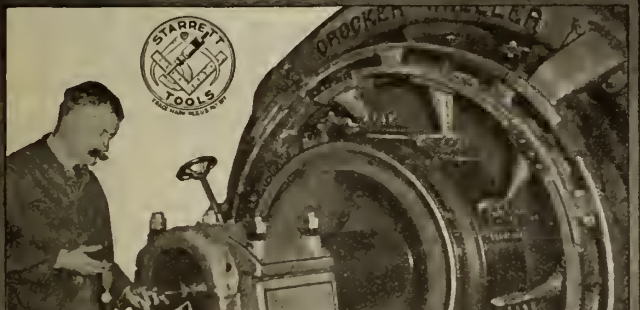

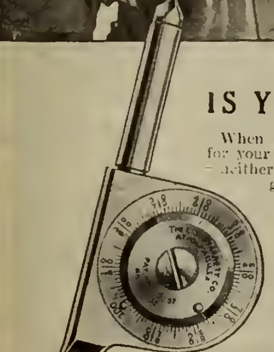

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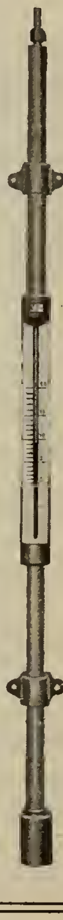

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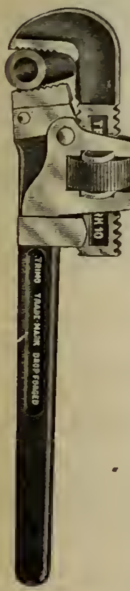

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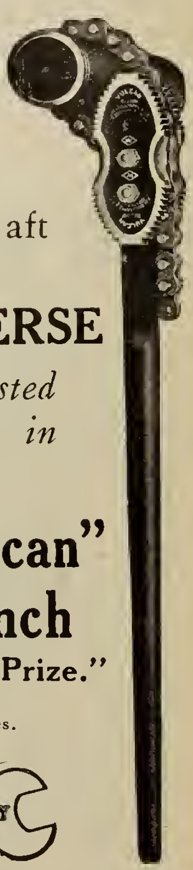

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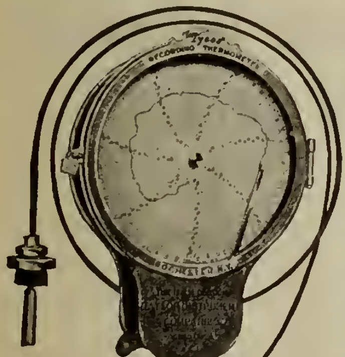

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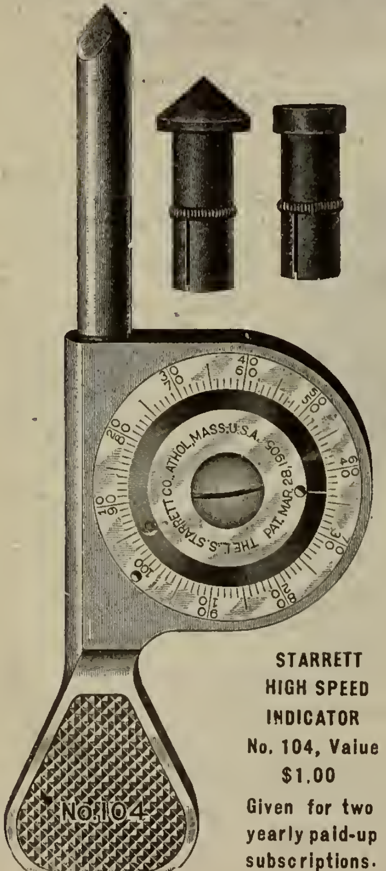
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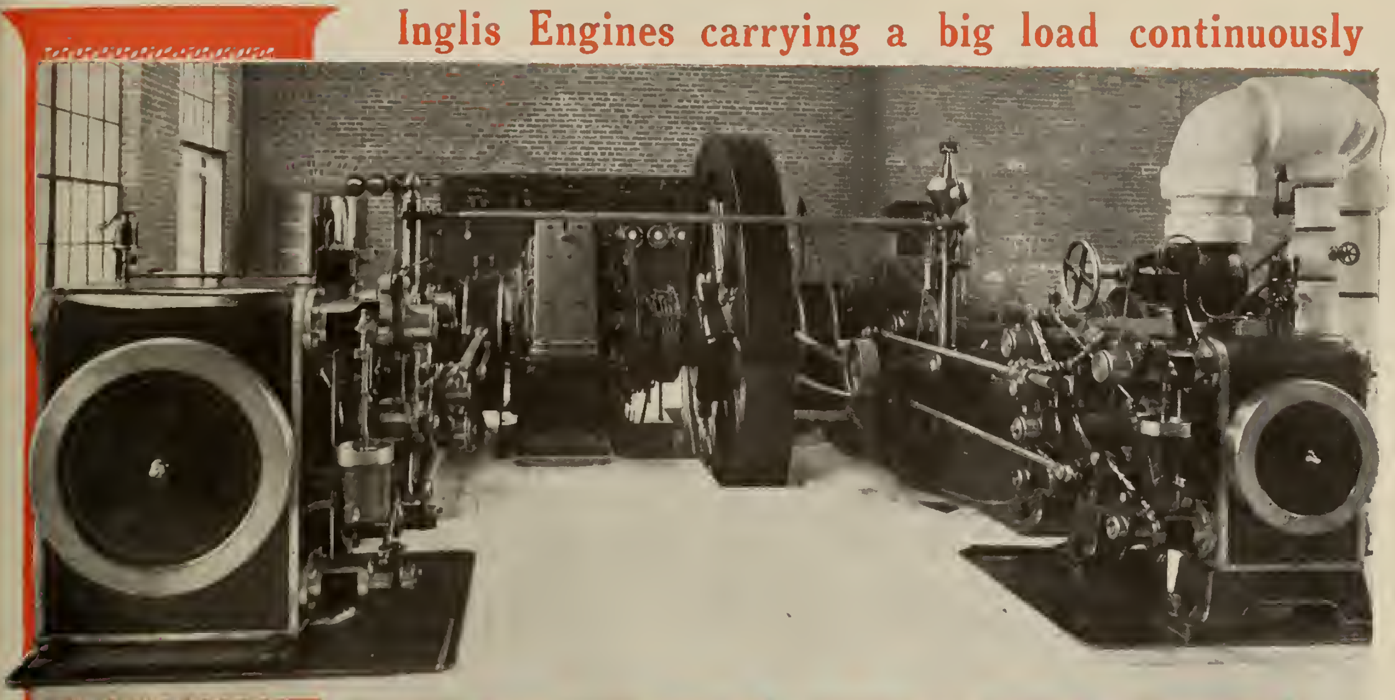

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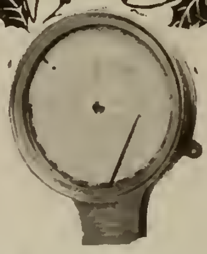

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